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ABSTRACT

This guide is devoted to the presentation and development of concepts dealing with conservation education in the public schools. The guide develops four overriding concepts: (1) The Wholeness of Earth's Systems; (2) The Effects of Ecosystems on Human Beings; (3) Human Beings Are Now the Most Influential of Earth's Organisms; and (4) Our Ability to Comprehend Must be Coupled With the Obligation of Self-Control. There are four segments, each of which covers a three-grade portion of the K-12 span. Each segment deals with the four concepts in the context of the specific grade span. Resource materials supporting concept development are cited. (RE)

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RESOURCES

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Preface

The *Colorado Model for Conservation Education* is an instructional tool consisting of two volumes. The first volume, identified on the cover by the word "Concepts," has within it the conceptual framework. A teacher can use this volume to plan instruction, and identify strengths and needs. The word "Resources" is applied to the second volume. It contains selected materials, strategies and activities keyed to the first volume — "Concepts." It is intended that these volumes can be applied in all curriculum areas. These are, however, merely suggestions for teaching particular topics and are presented to stimulate the teacher's imagination.

The Model was created to be used by teachers after successful completion of inservice sponsored by the Colorado Department of Education.

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To The Colorado Model for Conservation Education

The more Colorado grows, the more imperative conservation becomes. In achieving it, our schools play an ever-increasing role. Attainment of the life quality we desire for ourselves, for future generations, and for all living things that share the world with us, demands a high degree of student knowledge, attitudes, and behavior in the use of natural resources.

Most of us recognize that we must now abandon the reckless squandering of those resources that once seemed limitless. We recognize that they are finite, calling for our careful stewardship. We need to live in harmony with nature rather than to try to conquer it.

The Colorado Model for Conservation Education is a teaching tool. The State offers it, neither as a mandate nor a new course of study, but simply to suggest to school districts the blending of conservation principles into existing instructional programs.

People have the power to determine their destiny. The responsibility to maintain clean water, purify the air, protect our soils, and manage our energy will devolve upon this generation now in school. Their understandings through you of how these four elements interact with each other and with life will equip them to discharge their stewardship competently and beneficially.

Nutritional vitality is directly related to agricultural productivity which, in turn, is determined by our land-use decisions. Other land-use decisions govern the fate of the magnificent wildlife that is a Colorado treasure. Many species are either endangered or they flourish, survive or become extinct, as a result of our actions. Their health also reflects positively on environmental quality, serving as a barometer to signal trouble or well-being for humans.

A desire to live in harmony with natural systems and the skills to follow such a way of life are the ultimate goals of conservation education. If students leave school with an appreciation of these aims, all of us who are responsible for Colorado's educational system will have achieved one of the State's major objectives.

Richard D. Lamm
Governor

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INTRODUCTION

These teaching aids have been selected for use in connection with the Strengths and Needs sections of *The Colorado Model for Conservation Education*. As is pointed out in the opening chapter of that volume, "Suggestions for Using the Model," the strategies and activities mentioned here are merely suggestions. Teachers will find them easy to use and valuable in stimulating the imagination.

It is anticipated that the resources will be consulted when the rating scale that is part of the Strengths and Needs instrument reveals either that something is missing in the instructional program from a conservation standpoint or that some aspect of that program is less than satisfactory. It might be well to review the "Suggestions for Using the Model" chapter in the other volume before considering the material in this one.

Additional general information about the resources is given in the first page dealing with each of the four grade levels into which the Model is divided. The statements in the Strengths and Needs instrument are repeated for your convenience in conjunction with the relevant teaching aids.

These resources are organized so that as new or improved or more suitable suggestions come to light, they can be inserted without recasting the entire section.

The Model also was prepared for use by federal and state agencies to identify what new publications need to be developed — and which existing ones reprinted. It is intended that revisions of the Resources will be produced and made available by the Colorado Department of Education's Conservation Education Services and Project ACCESS. Teachers as they identify new, improved, or more suitable resources, materials, and ideas are encouraged to send their suggestions to Conservation Education Services.

THE MODEL APPLIED

The Model is divided into four major parts according to grade level — K-3, 4-6, 7-9, and 10-12. Each part is constructed around four basic concepts. These range through the entire spectrum of learning that sound conservation demands. The concepts are:

1

The Wholeness of Earth's Systems

The biosphere is a function of Earth's place in the solar system, and recognizing this fact is fundamental to understanding conservation principles and the completely inter-related life-support systems within the Earth's environments.

2

The Effects of Ecosystems on Human Beings

Natural forces and resources set the limits within which we develop our society. They provide us with the opportunities for creating the life styles we desire.

3

Human Beings are Now the Most Influential of Earth's Organisms

Technology has enabled us alone among all living creatures to control some life-support systems and to modify our environment significantly. The consequences to ourselves and to the plant and animal kingdoms are often serious.

4

Our Ability to Comprehend Must be Coupled with the Obligation of Self-Control

Every individual has a responsibility to use natural resouces wisely. Such stewardship is in the interest of self, of other people, and of all forms of life that share our planet. Every individual has opportunities to meet that responsibility every day.

RESOURCES

Grades K-3

The activities and teaching aids suggested here have been used successfully in the classroom, will be available at least through 1980, and for the most part are free or inexpensive. Each of the resources is keyed to its corresponding topic or goal in the Strengths and Needs instrument section. Usually more than one resource is suggested so that users not only will have a choice, but will help to develop materials better suited to their pupils. All resources suggested here fit into regular classroom activities or programs since this is not a new or additional course.

A list of agencies and institutions that offer extensive printed and audiovisual matter in their own conservation specialties is contained in the appendix for those who wish to delve deeper into these vast realms.

Throughout the "Resources," an asterisk(*) marks the names of all sources for more than a single recommended teaching aid or strategy. For example, the Soil Conservation Service is a prolific resource. The asterisk beside its name means that the address and other necessary details are carried in an alphabetical list, Appendix A.

Outdoor Biology Instructional Strategies (OBIS*) will be found useful in many areas where the Model does not specifically mention them. The complete set is becoming available commercially as this is written, but information concerning prices and where to get the material will continue to be obtainable from the originators by writing to OBIS, Lawrence Hall of Science, University of California, Berkeley, CA 94720.

Concept 1
Grades K-3

THE WHOLENESS OF EARTH'S SYSTEMS

Understanding the Biosphere

1. **Earth and everything on it make up a single inter-related, inter-dependent global complex that runs on a simple equation:**

WATER + AIR + SOIL + ENERGY = LIFE

No class will be taught the full meaning of this equation in a single lesson, or a year either. But children can acquire a pretty good idea of the essential unity of Nature by the end of Grade 3. They can become aware of the relationship of water, air, soil, and energy to living plants and animals. All the suggestions in this K-3 section of this model lead toward realizing that goal.

For a start, children can be introduced to the concept through a potted plant and a walk in the sun. Place the pot in a classroom window and have the class observe it for a few minutes each day. It will reveal much of the equation's truth. Water's role is noted when a child gives the plant a drink. The need for air is harder to explain, but can be related to a person's breathing. Soil supports the stem, and someone in the class may already know this is where the plant gets its food. Call attention to the way the plant turns to the light, and light is energy.

A walk in the sun near the school expands the idea. Children can feel the warmth, see more growing plants. One guide to explaining life's dependence on water, air, soil, and energy in this way, is in "An Outline for Teaching Conservation in Elementary Schools," the activity for Grade 1. The pamphlet may be obtained free from the Soil Conservation Service*. The activities for Grades 2 and 3 suggest a good follow up.

Observation and care of classroom animals or of pets at home can also bring out the relationship between the continuity of all life and water, air, soil, and energy. Teaching aids are obtainable from the American Humane Association*.

Alternative resources include Sets I, II, and III of *Outdoor Biology Instructional Strategies* (OBIS*).

2. **For all its simplicity, this is an awesomely encompassing idea. A start toward mastering it is for children to learn that the Earth is whole as well as round.**

Stories of the origin of the world, perhaps from Indian or other mythology, might serve as a lead from that to the wholeness of Earth. You can develop the same concept from *Project Learning Tree**, "An Individual Experiment," or from "Plants in the Classroom" from the National Wildlife Federation*.

An alternative is to use art work — either

teacher-selected or clipped by the children from magazines. Pictures of natural wildlife habitats make the point and hold class interest — an Arctic scene, a forest, a prairie, a marsh, a rain forest, a desert. Discuss the natural forces that moulded each system. Children might sketch their conception of an ideal region, including animals they like.

A more formal resource is "Plants Around a Building," OBIS*.

WATER

1. All water comes from precipitation — rain, snow, hail, sleet.

The facts of the hydrologic cycle — the succession of evaporation, condensation, precipitation, movement through or over the ground, and back to the oceans — are told admirably for all grades in a U.S. Forest Service* film, "The Adventures of a Junior Raindrop." The message of its 8 minutes of combined animations and photography might be reintroduced by such an assignment as having children make up additional episodes for Junior. The U.S. Forest Service film is on free loan from Cromar's Audio Visual Center* or the Colorado Division of Wildlife Library*.

A leaflet from the Soil Conservation Service*, "Conservation and the Water Cycle," contains a colorful diagram of the water cycle; it may be obtained free from your nearest Soil Conservation Service office. Request Bulletin No. 326.

An alternative or supplement is in *Project Learning Tree**, "Water You Know?"

2. Water is all-pervasive either as gas, liquid or solid. (Three-quarters of Earth's surface, two-thirds of a human body, etc., consists of water.)

Various visual testimonies to this are available. Whatever you show should include (1) the area of oceans in comparison to the land, (2) the amount of water in a massive rain cloud, (3) a glacier and the polar icecaps. Most telling of all is a demonstration of how much of the human body is water. One way is for students to weigh one of their friends, then stack buckets of water on the scale until they equal two-thirds of the child's weight. This is how much of the body is water.

Another good resource is *Water*, published by Time-Life Books. Although out of print, it is in many school libraries.

3. Almost all life on land requires fresh water, yet there isn't all that much of it in the form and places we want it.

Life's dependence on water will have been demonstrated in activities suggested above. But refer again to *Project Learning Tree**, "Water You Know?"

A wall map of the world can be used to show the relative scarcity of fresh water. The class can identify it; although you may have to explain that the little blue specks and thin blue lines on the land represent rivers and lakes, so small in comparison with the area of the oceans. Call attention to the white masses at top and bottom of the map, the polar icecaps. These hold more than twice as much fresh water as exists in all the rest of the world. If all water was represented by the size of this printed page, fresh water in liquid form and as vapor in the air would be as big as one-eighth of a single line of type (.6 of 1%).

If your school has the Rand-McNally SCIS* *(Science Curriculum Improvement Study)* kits, a resource for this learning adventure is contained in the Grade 1 section; see pages 29-32 in the Teacher's Guide "Organisms."

4. Abnormally heavy rains and prolonged droughts constantly change the amount of fresh water that nature bestows on any one region.

The Big Thompson flash flood of 1976 is an example. A collection of illustrated newspaper and magazine accounts of floods and droughts is a teaching device for making this point. Added to from year to year, it can be a continuing resource. From the collection, loose in a box or large envelope, a class as a reading task can arrange the clippings according to areas where the events are unusual and areas where an annual flood or long dry season is common. Children who cannot read still can grasp some of the power of these natural forces. If anyone asks, the longest drought ever was 432 years at a place in Chile, according to *Guinness Book of Records.*

*Project Learning Tree**, "Choose an Environment," page 9, is an alternative.

AIR

1. **Air supplies oxygen and carbon dioxide, which are essential to all life on Earth.**
2. **Air maintains a balance of these gases through a miracle of coordination to which both plants and animals contribute.**

A classroom terrarium demonstrates the carbon dioxide/oxygen cycle. (A terrarium is a useful aid for many other activities, as well.)

Ideas for the teacher are contained in the Audubon Society's* "How to Make a Terrarium," 5 cents. Teachers find that a fish tank discarded because of a crack makes an excellent terrarium and becomes a lesson in recycling.

You can lead the class to the discovery of how air renews itself within the closed environment of their terrarium. It happens here just as in a garden or forest. Explain if necessary that all animals breathe as we do to get oxygen, and exhale carbon dioxide, also as we do. Green plants are just the reverse, taking in carbon dioxide and giving off oxygen. The exchange keeps the air fresh in the terrarium, as it does in nature.

An alternative is described in the booklet "Wind" from the National Wildlife Federation*.

3. **Air in motion helps keep Earth's other systems in balance. It takes rain to its destination, carves out beautifully distinctive landscapes, even powers windmills and boats.**

An easy introduction to air in motion is to have students find pictures in magazines or newspapers and arrange a display of: (1) a large rain cloud — vapor driven, often a very long way, by wind; (2) dust bowl storms — masses of topsoil taken from the land; (3) sand dunes — a pattern of wind's motion, magnificently displayed in Colorado's Great Sand Dunes near Alamosa; (4) windmills and sailing ships. The class can relate each picture to the air.

If you use story-telling as a teaching technique, you might consider one of the myths about the origin of the four winds — an Indian legend, perhaps, or a classic Greek or Oriental fable. See *The Uses of Enchantment, the Meaning and Importance of Fairy Tales,* by Bruno Bettelheim, $3.95, paper, Random House, 201 E. 50th St., New York, NY 10022.

An alternative or supplementary activity that demands greater student participation and can be combined with 2 Energy 1 below is in a series prepared by the National Science Teachers Association for the Department of Energy*. The series is called *Interdisciplinary Student/Teacher Materials in Energy, the Environment and the Economy.* See Lesson 6, "Wind Is a Source of Energy," pp. 25-27 in Volume No. 6, "The Energy We Use, Grade 1."

4. Birds and all creatures that fly are an integral part of the ecosystem.

Show pictures of birds in flight. Have the class then tell stories or give their own impressions of how the freedom of the air allows birds to play their part in the wildlife system.

SOIL

1. Soil directly or indirectly nourishes all life on land. It is one end of the food chain.

Some teachers have the class bring to a nutrition lesson pictures of their favorite foods or of food they had for dinner the night before. With these or other food pictures, students can diagram on the chalkboard or in their notebooks links in the food chain that will trace each item to its origin. Keep asking, "And where does that come from?" until the class discovers soil is the ultimate source. For an excellent diagram of the food chain (and useful information for the teacher), see "Helping Wildlife"* by Delwin E. Benson, page 2.

In schools using the Rand-McNally SCIS* kits, see "Beginnings," the kindergarten Teacher's Guide, pp. 88-94, for activities that deal with the subject on a scale to match the children's age.

2. Soil appears upon the Earth as the result of a long, slow process of weathering and decay.

Students can discover how slow the process of soil formation is by making a little themselves in the classroom. Directions for doing it without much mess are contained in the Soil Conservation Service*, *Teaching Soil and Water Conservation,* Activity 1, "Make Some Soil Artificially," and Activity V, "How Does Organic Matter Help Soil Structure?" The guide is free from the nearest Soil Conservation Service office.

3. Minerals, ranging from base metals to gems, are found in many kinds of rocks.

One approach is to have the class play "animal, vegetable, or mineral" for a few minutes, then ask where the minerals come from. It helps to display on a table different kinds of rocks, including ore samples. Discuss the treasures we get from rocks — base metals, precious metals, gems. In an art lesson, children might draw their versions of how each one of the three is used.

ENERGY

1. Energy is the capacity to do work. This means work of all kinds — what makes wind blow, trees grow, water flow, the Earth spin.

A good simple introduction to the nature of energy is in "The Energy We Use, Grade 1" (cited in 1 Air 3 above), Lesson 1, "What is Energy?" and for reinforcement Lesson 3, "Energy Is All Around" from the Department of Energy*.

More elaborate activities combined with films are suggested in "Energy and Conservation Education Guidelines — Grades 1-3," one of a series of notebooks produced by *Energy and Man's Environment* (EME*) and made available to Colorado schools through the Colorado EME group. See especially Lessons 1-3 in Activity 2, "Let's Learn About Different Energy Sources," in the Sources section. Students discover the meaning of energy in broad terms, using a variety of materials and equipment. Activity 1, "Energy Talk," is a possible preliminary. This is a question and answer game introducing children to energy.

2. The sun is the original source of all

energy. Energy can be neither created nor destroyed on this Earth.

A good beginning to discovering the sun as source of all energy is Lesson 4, "The Sun Is a Source of Energy," pp. 11-12 in "The Energy We Use, Grade 1," Department of Energy*.

An alternative for storytellers is one of the legends about the sun's origin. Among American Indian versions is "Why the Sun Rises Cautiously" in *Why the North Star Stands Still,* by William R. Palmer, Prentice Hall, Englewood Cliffs, NJ 07631. Another is "How the Seasons Were Set" in the same volume.

As to the indestructibility of energy, see "About Heat and Light," Activity 7, in the Conversion section of the EME notebook*. This involves experiments with materials and equipment easily obtained.

3. Some energy resources are renewable; others are not.

"We Use Fossil Fuels," Activity 5, pp. 13-24 in "The Energy We Use, Grade 1" (Department of Energy* Volume No. 6) gives children an opportunity to find out why coal, oil, and natural gas are nonrenewable. Activities 6 and 7, "Wind Is a Source of Energy" and "Water Is a Source of Energy," deal with renewable sources.

The EME notebook* offers an alternative, Activity 4 in the Limits secton, "How Long Will It Last?" starts with the finite nature of flashlights, candles, and food, eventually arriving at coal, oil, natural gas, and wood. Also see "My Story About Coal," Activity 3, in the same section. Students could write a story after seeing a film or reading a fairy tale.

LIFE

1. Availability of water, air, soil, and energy in combination governs the development of life everywhere in the world.

This may be taught by dividing the classroom into three or four "natural areas" — forest, desert, marsh or lake, and prairie. Assign equal numbers of the children to each of these environments. Ask them to select roles as plants or animals appropriate to their environment. If the choice does not come easily, the choices can be made for them. Ask each to describe the needs of the plant or animal represented in terms of basic habitat values — food, water, shelter, space, and the arrangement of these. You might ask what differences of water, air, soil, or energy are required. Explain the differences in the plants and animals of these regions.

As an alternative, or better still as a supplement, see "Trees as Habitat," *Project Learning Tree**.

2. Plants support all animal life. They draw nutrients and water from the soil, carbon dioxide from the air, and energy from the sun. Nature's "web of life" forms an intricately delicate balance.

In "The Web of Life," *Project Learning Tree**, each student researches the life style and needs of a different animal. The information gained when put together as a class mural, reveals one ecosystem's web of life. As an introduction to conservation by recycling, some classes construct the mural from shopping bags cut open and taped together. A roll of butcher's paper is less crude.

Another way to construct a web of life is for each student to hold a magazine picture of a plant or animal in its appropriate habitat. Then let each hold one end of a string to all the others who play a part in the life cycle of the plant or animal represented. But no one lets go of the other end of the string. Soon the strings will crisscross the room most graphically. The

activity is most effective when students are prepared with knowledge about the animal's behavior, needs, and characteristics.

3. **One feature of the wholeness of the Earth is the slow change in an ecosystem, as from pond to marsh to thicket to forest.**

An example would be a series of pictures shown in this order: (1) a lake or pond, (2) a marsh, (3) a thicket, (4) a forest. Lead a discussion on the progression that takes place through natural changes, say a failure of the pond's water supply. The life in it disappears and is replaced by typical marsh residents, both plants and animals. Further drying, and the marsh grass gives way to a thicket, and the waterfowl to rabbits and larger animals. Eventually the thicket is crowded out by trees, and we have a forest with changes again in wildlife species and populations. (A colorful chart appears in "Helping Wildlife."*) During the discussion, a student at the chalkboard might depict the changes, starting with the pond and ending with the forest.

4. **Another aspect is the preservation of population balance among various species within an ecosystem.**

Students who have completed a "web of life" exercise might consider what happens to one species in a given environment when the animals that naturally prey on this species are exterminated. For example — what happens to the rabbit, robin, or grasshopper population when their enemies disappear? An arithmetic lesson can be devoted to calculating the population explosion. The class is provided with the average life span of the chosen animal, the average number of progeny for one pair, and the number of times a year it reproduces. This is shown graphically and well explained on page 15 of "Helping Wildlife."*

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Concept 2
Grades K-3

THE EFFECTS OF ECOSYSTEMS ON HUMAN BEINGS

Understanding Human Dependence on Nature

1. **Where and how well most people live is dictated by the kind of ecosystem in which they were born or to which they migrate. (E.g., Note the Eskimos and Pygmies or people of the mountain and plain.)**

One approach is to show pictures of the life of plains Indians and upland Indians, of the early ranchers or farmers on the prairie and miners in the mountains, of Eskimos and Pygmies. From these, students can identify the environmental influences that determined the clothing, homes, foods, and games as well as work of these varied peoples. The most striking contrast due almost entirely to the ecosystems is that between Eskimos and Pygmies when first seen by Westerners, since they are in the same primitive stage of hunters and gatherers.

2. **Earthquakes, volcanic eruptions, tidal waves, and significant changes in climate may alter an ecosystem drastically. The inhabitants must adapt, migrate, or die.**

The Flood is the classic example. Other examples for children to see would be in picture stories of the Midwest dustbowl of the 1930s, that drove so many "Arkies" and "Oakies" to California, the destruction of Pompeii or the eruption of Mont Pelee, the San Francisco or Tokyo earthquakes. The point to be made is that in the face of such natural forces we are almost as helpless as the most primitive peoples.

WATER

1. **The peculiar relationship of water to land has been decisive in developing civilization.**

   A. Most of the world's cities began as ports.

   B. Peoples who depend upon fish and other aquatic life have cultures strongly influenced by that fact.

1A. If the class names the ten or twelve biggest cities in the world and locates them on a wall map of the world, it will be seen how many are ports. Even such inland cities as St. Louis, Chicago, and Paris are on rivers or lakes.

1B. Fairy tales of fisher folk contrast with those of inland people. See "The Uses of Enchantment" cited in 1 Air 3 above. The different environments help explain the different attitudes revealed in

the stories.

As an alternative, children might create in drawings or cutouts a typical fishing village, costumes, and fishing equipment.

2. Access to good fresh water dictated the sites of inland cities, many industries, and most farms.

One way to introduce the importance of water is to ask the class to tell you all the places they can think of that incorporate the words "springs" or "wells" or "water" in their names. Or use "Water You Know?" in *Project Learning Tree**.

3. However much we rearrange the distribution or flow of river systems, the total amount of water is only what the hydrologic cycle releases.

Dr. John Loeffler of the University of Colorado has pointed out that every drop of water that falls on the state eventually goes out to some other state, but no water from any other state ever gets to Colorado. Tell your class that, and then, referring back to 1 Water 1 above, ask where our water does come from. The answer is precipitation. Have students trace on a map how water leaves by way of our major rivers. See also "Water Cycle," the first two pages of a colorful eight-page booklet, "Water, Where It Comes From and Where It Goes," obtainable from the producers of *Captain Hydro**.

AIR

1. Daily and seasonal changes in air temperatures prescribe much of what we do almost every moment of our lives.

Many children's stories illustrate the point. They are good material for students learning to read or the teacher can narrate them. Perhaps some member of the class already knows one and will volunteer to tell it. An example is "Why Tobate Made Winter" and "How the Seasons Were Set" in the volume cited in 1 Energy 2 above. *Why the North Star Stands Still.* Also, children can make up their own stories on how temperature influences their own actions.

2. The vagaries of air in motion may become matters of life and death, as when a gentle breeze swells into a tornado.

Stories of hurricanes, typhoons, tornadoes, cyclones abound in real life. The heaviest loss in a windstorm was 200,000 killed in a Pakistan cyclone in 1970. If any of the children has seen "The Wizard of Oz," he/she might explain how the story opens. Windstorms really have been known to lift houses into the air. Pictures of such events give a class an understanding of the power of the wind.

SOIL

1. Soils were almost as important as water in influencing the original locations of human settlements.

If children have read or heard stories of the settlement of this country, you might ask them what farmers from the East and South were looking for when they came to Colorado. The likely answer is gold, but ask what those who came to stay wanted. The answer is land — the family from New England and the family from Mexico. But whether they sought mineral or agricultural wealth, they were drawn to Colorado by what was in the ground. Your local library or historical society probably can provide stories of early settlers to show your class how the soil influenced the type of community.

2. People depend for nearly all their food

and much of their fibers on fertile land that can hold water and nutrients for plants to absorb in the quantity we need. Soil of that quality is limited, 2-4% of Earth's land surface.

See *Project Learning Tree**, "What's in Soil." A map of the "Major Agricultural Regions" in *Goode's World Atlas** will show the class how little is cultivated. The map will show roughly all land being farmed, not just the really fertile areas, but very large open spaces remain, even in the U.S.

Children might draw pictures of food they eat that comes from plants, and tell where these plants got *their* food. If you place a plant with an extensive root system in a glass jar in a way that the roots can be seen, students can observe how the soil holds water and materials that the roots absorb, and supports the stem, and how roots absorb.

3. Minerals, basic material in many of the things we use, exist in fixed quantities and once taken from the ground cannot be replaced.

You may wish to start this by having students bring to class or draw in class pictures of things they see in the home, in school, or on the way to school that contain minerals. (Define minerals for them if necessary.) List the items on the chalkboard as a child displays a picture and ask where the mineral came from originally. It will be "from rocks" or "from the ground," but all will not be replaced as plants renew themselves.

ENERGY

1. All human beings get their bodily energy from a renewable resource — food.

In the EME notebook*, Uses — Activity 10, "The Apple Factory," students trace their own food chain, beginning with the sun. Conversion — Activity 4, "Food — Energy and You," makes the point as students learn about the calories in a school lunch.

An alternative is that during a nutrition lesson, consider as energy sources the various foods being discussed. Do we get our bodily energy from any other source?

2. Industrialized societies depend for most of their energy on fossil fuels. These are nonrenewable.

EME notebook*, Sources — Activity 5, "Questioning 'yes' or 'no,' " is a simulation game in which participants become familiar with energy sources of various kinds. On a slightly higher level is Activity 4, Limits, "How Long Will It Last?"

An alternative, "The Energy We Use Grade 1" from the Department of Energy*, deals with this in several simple activities in Lesson 5, "We Use Fossil Fuels," and to some extent in Lesson 3, "Energy Is All Around."

*Project Learning Tree**, "Another Way of Seeing" enables children to compare their own way of living with that of some early Native Americans.

Another approach is to have the children mention the energy sources that provide for their own comforts and conveniences — electricity, transportation, heating, cooling. If they do not mention manufactured products, these might be suggested to them as paper, clothing, toys, etc. The source for all items will usually be coal, oil or gas. Will nature replace these fuels? They are not like wood or wind. Why not?

LIFE

1. The natural environment controls

many factors that contribute importantly to our way of life — the style of our houses, foods, games, clothes.

A class may explore the natural forces of their region that determine certain features of their own homes, foods, sports, and clothes. As a preliminary, a class might benefit from a mainly outdoor lesson on a single feature of the environment. Children might study natural coloration, protective coloration, mimicry, and so on.

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2. Wildlife is one of the ecosystem's natural resources upon which people depend.

The film "Where Should a Squirrel Live?" is one device to open a discussion of why we should leave animals in their natural surroundings. This seven minute story of a baby squirrel rescued and taken back to his natural habitat by caring people is obtainable on loan from the Colorado Division of Wildlife Library* and is suitable for any grade level.

Alternatives are *Project Learning Tree**, "School Yard Safari" and "The Native Way, a Natural Lifestyle." Or build your own wildlife activity around *Fishes of Colorado* or the Bilingual booklets on *Game Animals of Colorado, Game Birds of Colorado* and *Furbearers of Colorado* obtainable from the Division of Wildlife Library* or Conservation Education Services, Colorado Department of Education.

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Concept 3

Grades K-3

HUMAN BEINGS ARE NOW THE MOST INFLUENTIAL OF EARTH'S ORGANISMS

Understanding Human Impacts on the Environment

1. **We are neither the largest, strongest, hardiest, nor most agile creatures on Earth. Our dominant position as compared to other forms of life now on the planet is a product of intelligence and our ability to use tools (technology).**

Students can discover through classroom and outdoor lessons that human and natural communities are essentially alike, but that the human community has developed much more extensive facilities based on technology — the telephone as against the warning call of the jay or squirrel, and so on. Children can compare buildings in the city with the structures of beavers in water, burrowers underground, or birds' nests. In this connection a film, "Realm of the Beaver," may be useful. It runs 25 minutes and shows the animal's place in the West and on free loan from the Division of Wildlife Library*.

2. **Technology coupled with work enables people to bend nature in many ways to suit their own convenience.**

In *Project Learning Tree**, "Long Range - Short Range", students explore the impact of human technology in the matter of obtaining a winter supply of firewood.

You may prefer such an approach as asking the class to name products in common use or features of the community that exist because people have been able to alter natural processes. Guide them toward naming the paving or building over of large areas, extraction of metals and fuels from under the ground, farming areas once in forest or grass, diversion of natural water flow into reserviors and irrigation channels. How have these human interventions in the environment changed other conditions than the obvious increases in the comforts and conveniences of our lives?

3. **Human intervention in the environment causes profound changes in the living world through:**

   A. **Domesticating plants and animals;**

   B. **Intruding on wildlife habitat, sometimes to improve, other times to damage or destroy it.**

Contrasting pictures of indigenous plants and animals before the days of permanent settlement, and since, are one way to demonstrate this. Examples are the vast bison herds and a modern cattle ranch, a woods and an orchard, a stretch of virgin prairie and an irrigated field in the same area. Ask what has happened to the wild species displaced by the domesticated plants and animals or by the town. See "Helping Wildlife,"* pp. 21-24.

*Project Learning Tree**, "Forest Consequences," can be used by students to demonstrate knowledge of the effects of human and nonhuman activity in forested areas. See "Outdoor Manners Coloring Book." An excellent supplement would be a field trip to the Plains Conservation Center*, 2,000 acres restored to much of its original state as to vegetation and animals. It has a sod house, early homesteader's equipment, and many other features. The Center is just east of Denver on East Hampden. For appointments call 771-1166 or 683-1673, or write to Evan E. Obrecht, 4932 Parker Road, Aurora, CO 80015.

WATER

1. People use fresh water in more ways and greater volume than do other forms of life.

One approach it to ask the class to name as many human uses of water as they can — you may have to suggest some. Stop when the list reaches ten or twelve. Write them on the chalkboard as they are mentioned, as:

household uses
farm irrigation
sprinkling lawns and gardens
commercial establishments
factories, industrial uses

Set out a container in which you have placed eight cups of water to represent a complete community water supply. As each use is noted on the board, have a student take out one cup of water and pour it into an empty container. The water will be gone before the last couple of uses are reached. What can be done? If each of the previous users saved a little, there would be enough for all.

Alternatives are the extension section of "Water You Know?" in *Project Learning Tree**, or "Water, Where It Comes From and Where It Goes," a colorful eight-page booklet from *Captain Hydro**.

2. Human demand for fresh water is so great that in size man-made waterworks rival all but the biggest natural systems. In consequence, they have great impact on the environment.

Pictures of major dams, tunnels, reservoirs, and filtration plants in Colorado as well as large users such as industries, farm irrigation, the waterworks of a big city might introduce the *Captain Hydro** "Water Play." This is a colorful 16-page booklet of games and puzzles that deal with people's uses of water and how to conserve it.

3. The changes we make in the quality, flow, and natural storage of water alter aquatic wildlife habitat significantly.

The booklet "Estuary" from the National Wildlife Federation* suggests strategies. These bodies of water are among the most endangered of aquatic wildlife habitats in the U.S. Or develop a discussion of what happens to the fish and waterfowl in Colorado's lakes, streams, and marshes as a result of: (1) pollution or diversion of water, and (2) the protective measures of sound wildlife management as outlined in "Helping Wildlife."*

AIR

1. Application of technology has done some dreadful things to the air, but can also undo them.

An easy practical demonstration is to place a clean white sock over the end of an exhaust pipe on a car parked at the school (be sure it has cooled); ask the owner to start the motor and let it idle for a minute. Remove the sock

(carefully, the pipe may be hot) and have students observe the contents. How much of this pollution does the air receive in an hour from one car? From a thousand cars? What other sources of air pollutants can children name? You may have to suggest some of the natural ones such as dust and pollen.

2. **Human values are weighed and debatable issues decided mostly by means of government. These values usually determine what happens to air.**

If the class carried out some such activity as suggested in the previous paragraph, they might consider what can be done about the problem. Pursue this by inquiring if any student has heard parents or others talk of what is being done or ought to be done to clean the air. Topics for discussion might include: federal or state emission standards for cars; local rules about smoke from industry, incinerators, burning leaves. Should we have more such rules? In answering these questions, the class will have been engaging in a political process; you may wish to point this out.

SOIL

1. **Land use has put the stamp of civilization on enormous sections of Earth's surface, especially on the soils that produce our food and fibers.**

Teachers might start by asking students how much of the land they saw in the course of the day before was in its natural state. Even when they go into the country, how much of the land is under cultivation, grazed by domestic animals, built on, or otherwise used by people? The map of the world's croplands (2 Soil 2 above) shows that most of the cropland is in North America, Europe, Russia, India, and eastern Asia. A map of "Density of Population" printed in *Goode's World Atlas** reveals that except for the Western Hemisphere and Australia, the land farmed is where the most people live. Can students explain why countries with much cropland have relatively sparse populations? The Western Hemisphere and Australia are exporters of farm products — the U.S. alone produces half or more of all food imported by the rest of the world.

2. **Farmers and gardeners often save and improve soil on sloping land which, left alone, would be claimed by water and wind erosion.**

The Soil Conservation Service* booklet, *Teaching Soil and Water Conservation,* offers good suggestions in Activities X, "How Does Crop Cover Affect Soil Loss?," XI, "How Does Mulch Prevent Soil Loss?," and XII, "What Does Contouring Do?" The Soil Conservation Society of America* provides a 16-page comic book, "The Story of the Land," with a covering Teacher's Guide which deals with this subject as well as with land abuse. "Outdoor Classrooms on School Sites," also published by the Soil Conservation Service*, can be tied to this.

3. **Land use has equally powerful impacts upon wildlife. In one place, we may disturb the habitat, in another help the plants and animals to flourish.**

Invite the district wildlife manager of your region to talk to the school. (Arrange with other classes to hear him in order to get the full benefit of the visit.) The Division of Wildlife* booklets mentioned in 2 Life 2 above will help to prepare for such a talk. The booklets also can be the basis of an independent lesson on the impact of people on wildlife, both beneficial and harmful.

An alternative suggestion is The Soil Conservation Society of America* comic book,

"Making a Home for Wildlife on the Land," with its Teacher's Guide.

ENERGY

1. Only people, among all living things, exploit nonrenewable metals, minerals, coal, oil, and gas. This has left an indelible mark on many landscapes.

*Save the Earth, an Ecological Handbook for Kids**, by Betty Miles (Alfred A. Knopf, 201 East 50th St., New York, NY 10022) is a good introduction to this aspect of human impact on the environment, including the problem of waste management.

Alternatives are EME notebook*, Impacts — Activities 1 and 2, "Cleanbee," and "What Is Energy?" The next three activities develop the theme in more detail: "Water Pollution," "Your Nose Knows," and "Every Litter Bit Helps."

2. Human demand for these resources rises so rapidly on the wings of technology that in this century we have consumed more than did all our ancestors through all the millenia of history.

"The Energy We Use, Grade 1," issued by the Department of Energy* deals with this in Lesson 5, "We Use Fossil Fuels." In the same series, Volume 5, "Community Workers and the Energy They Use," the problem is taken up in terms of energy-related occupations. See also the draft of the volume "Energy and Transportation." Ask for the title and number, HCP/U3841-0001. (All are free.) An alternative is EME notebook*, Uses — Activity 6, "Energy — How Do We Use It?"

3. Different life styles and cultures have different energy needs and wants.

Save the Earth (See 3 Energy 1 above.) suggests differences in energy needs for different life styles. An alternative is EME notebook*, Uses — Activity 2, "Energy Trip Ticket Game." The actual game is preceded by group work in making collages and a discussion of where and how the energy depicted in the collages is used.

LIFE

1. Much of the immediate environment in which most of us spend our lives is our own creation, even the five needs of all life — food, water, shelter, space, and arrangement of these necessities.

*Save the Earth** (See 3 Energy 1 above.) covers the complex human impact on the environment. *Project Learning Tree**, "The Second Little Pig," deals with the building of a home (shelter), but the rest of the concept can be carried on from there by developing the lesson's suggestions in terms of water, food, space, and arrangement as well as shelter.

2. An inescapable question about the impact of human activities on environment is: "What happens to other forms of life?" Wildlife is an excellent barometer for such a measurement.

If the region's district wildlife manager is available as a speaker, ask him to discuss the impact of our civilization upon the rest of life. On a visit to a nearby open space — park, woods, farm — students may observe what is being done to protect and nourish plants and animals, and what endangers any species. A field trip to one of the state or national parks would give the class a chance to observe much more in a natural setting, and to listen to a knowledgeable person explain and answer questions. Be sure to write in advance for an appointment. A trip to the Plains Conservation Center* just east of Denver (See 3 Understanding 3 above.) is also recommended.

Hunting and fishing are obvious ways in which people affect the wildlife of this state. Members of your class may have heard their elders talk of hunting or fishing trips. Have these children bring in pictures of the excursions along with the stories. Did the hunters or fishermen speak of regulations — licenses, limits, open seasons? Why are these rules in effect? (Teachers who wish for background information see *Today's Strategies ... Tomorrow's Wildlife,* produced by and available from the Colorado Division of Wildlife*, 96 pages, illustrated, $3.)

Concept 4
Grades K-3

OUR ABILITY TO COMPREHEND MUST BE COUPLED WITH THE OBLIGATION OF SELF-CONTROL

Understanding Human Responsibilities and Opportunities

1. **Conservation is necessary for the sake of present and future generations of plants, animals, and people. Wise use of our natural resources is *the* responsibility.**

*Project Learning Tree**, "Classroom Conservation" is a guide to the students' "wise use of natural resources." Also *Save the Earth** (See 3 Energy 1 above.) is excellent on conserving land, air, and water, especially in the "How to Do It" section.

2. **The opportunities to be identified are those in which youngsters of this age can participate.**

"The Litter Monster," a 15-minute film, shows the type of cleanup activities children can do. (You may wish to point out that part of the film was shot in Colorado.) It is obtainable on free loan from the Colorado Division of Wildlife*. After seeing this film, children in the early grades of several schools have constructed their own "litter monsters" and placed them around the school, in shopping centers, and other key points in the community.

As an alternative or supplement, see Activities 13-15 in the Impacts section of the EME notebook*. These activities deal mainly with recycling and the trade-offs involved in this sort of conservation. *Project Learning Tree**, "Classroom Conservationist" addresses this issue.

WATER

1. **Conserving this precious resource means detecting waste and inefficiency, using water wisely and accepting sacrifices.**

One approach is for children to list the ways they use water every day, and then suggest how they could use less. Write the uses and proposed savings in separate columns on the chalkboard. Let each child (if at the writing state) copy this and keep an individual record of actual savings each day for a week.

It is important that they record the amounts. For example: Do they run the water while brushing their teeth? If so, have them do this once more with the stopper in the basin to see how much water they will save when they shut off the tap. (The average is eight liters, about two gallons a brushing.) Similarly for washing, helping around the house, drinking, sprinkling the lawn, etc.

Sometimes it is useful to set a goal, say a saving of 60 liters (over 15 gallons) a day per capita. In

any case, add up the total of class savings per day and multiply by 365. If this is beyond the skill of your class, do it for them. Then estimate how much space the year of water conservation would fill — the school room, the whole building, so many swimming pools? How much space if the whole school did it? The whole town?

Most of the saving will be in preventing waste, probably. As each saving practice is reported, you might ask if it entailed loss of comfort or convenience. What sacrifices beyond their current savings would the class make if still further reduction in water use were to be imposed?

2. **Conservation may also require adjusting activities and life styles to prevent water pollution, especially through waste disposal.**

"Water Follies, a Soak Opera," is a film produced by SP Associates and may be purchased from them ($125 — Box 5268 Terminal Annex Station, Denver, CO 80217). It is a seven minute color cartoon depicting a day in the life of a water wasting family. Many school districts already own it, and schools may borrow it (free loan for one week) by writing to Public Affairs Dept., Denver Water Department*, Denver, CO 80254. A 12-page coloring book was adapted from the film by the Sacramento, California, Municipal Utility District.

Alternatives are games from the *Captain Hydro**, "Water Play" or the back page, "Conservation," the same source's "Water, Where It Comes From and Where It Goes."

3. **The trade-offs and decisions involved are neither easy nor clear. (We can make water so clean that fish can't live in it.)**

One way to teach this is to invite the class to consider what they would be willing to sacrifice to keep water clean and adequate to the needs not only of themselves but of other people, plants, and animals. They will not have encountered some important problems. But they can address such questions as: What to give up for a lovely lawn? Should we have a new city reservior or keep the canyon? Should the marsh with its beautiful waterfowl be drained to provide new farmland?

Such a discussion might be enlivened by showing the slide show "Wildlife Needs You," made by the National Wildlife Federation* and available there for $10. The Colorado Division of Wildlife Library* will lend a set free to any school in the Denver metropolitan area that can pick it up and bring it back.

An alternative is a 13-minute slide show in color, "Water Conservation, It's Up to You," starring Beauregard Beaver discussing why we should conserve water, draws the parallel to animal needs, and tells how to do it. It is on free loan for one week from the Denver Water Department — address in 4 Water 2 above.

AIR

1. **Air pollution problems pose more trade-offs and more decisions: A. The automobile, B. The home, C. Industries, including utilities.**

By this time in their studies, children are probably prepared to investigate what might be done to protect air quality. In 3 Air 1, the basis of such an investigation is contained in the series prepared by the National Science Teachers Association for the Department of Energy*. Seven lessons have been combined in a volume on "Energy and Transportation," aimed at third graders. Lesson 6, "Danger! Unfit for Human Use," pp. 37-50, deals with air pollution. The activities are designed to consume four or five class periods. Students analyze the cause of air pollution and then explore methods for controlling or reducing it.

Pollution by land, air, and water transportation is stressed.

SOIL

1. Soil care was the earliest conservation practice, applied in many cultures from ancient Egyptians to American Indians.

Students may be familiar, by this time, with the perils to which soils are exposed, both in nature and by the works of man. Now they can discover the respectable priority of soil care through such a device as a series of pictures illustrating how it was done through the ages: (1) terraces that have kept hillsides in cultivation for thousands of years, (2) works built along the Nile 4,000 years ago to take advantage of the annual flood, (3) great bench terraces in ancient China, (4) fruit trees in France on hillsides cultivated since before the Christian era. You can find these in a booklet, "Conquests of the Land Through 7,000 Years," available free from the nearest Soil Conservation Service* office. You may wish to add American Indians planting a fish in each hill of corn and study Hopi terraces.

2. Careful farming practices, including replenishment of nutrients in the soil, conserve and enhance productivity. But we still must make hard choices. Farmers, for example, select a method of cultivation from several options.

Farmers today practice more methods of conserving and improving soil than the ancients knew. Students can demonstrate some of them through classroom experiments described in the Soil Conservation Service*, *Teaching Soil and Water Conservtion,* Activities X, "How Does Crop Cover Affect Soil Loss?" and Activity XII, "What Does Contouring Do?"

Students can build and maintain a compost heap in the corner of the school grounds. This can help to show the value of returning to the soil elements extracted from it. The school lunchroom can supply garbage. If the compost heap is maintained, the children will have the satisfaction of seeing it used on the school garden.

3. The scarcity of some minerals means that we must use them carefully and re-use them whenever possible.

If children have visited an abandoned mine, they may be able to describe it. Or you may want to show pictures of such mines. What kind of a mine was it? Do they know why it was abandoned? Does a worked-out mine replenish the minerals? Answers will lead to the discovery that to conserve our mineral resources we need to re-use metals particularly. What do students know about recycling programs in the community? Are cans and bottles saved for recycling in their homes? Does the school have a recycling project? The importance of recycling and re-using metals can be introduced, or included with the suggestions made in 4 Life 1 below.

ENERGY

The values and issues at stake in energy conservation are the same as those for water conservation:

1. Recognizing wasteful or inefficient uses, converting to wise uses, accepting possible sacrifices.

One well-liked method is to play the same game with energy as is suggested in the water section above. It will not be so easy to calculate the savings, but children can keep track of the amount of time they had a light off that was formerly on; refrained from using an electrical

appliance; how far they walked instead of being taken by car, etc. Total savings per day can be estimated by using a table of energy consumption by various items of household equipment. The EME notebook* contains such a table in Activity 11 of the Impacts section.

Suggestions for ways to conserve energy, and a check sheet that you can duplicate for the class, is in "The Energy We Use, Grade 1" Activity 8, pp. 35-36, "Energy Conservation" (Department of Energy*).

A similar activity covering more ground is EME notebook*, Impacts — Activity 11, "Ways We Use and Save Energy." This suggests many more types of energy savings than do the other resources. Included is energy that goes into a pop bottle or a can that is recycled, paper not used or re-used, etc. A good activity on recycling is in the same volume, Uses — Activity 1, "Something Useless."

2. Adjusting activities and life styles to prevent pollution.

"The Energy We Use, Grade 1" (Department of Energy*) ends with an ambitious, dramatic performance in which every member of a large class can take part. It calls for a minimum of 10 actors. This Activity 9, "The Best Present of All," is adapted from the comic book of the same title published by the National Wildlife Federation after it appeared in *Ranger Rick's** nature magazine. The play is not only a message for preventing pollution but also deals with this Model's next item, trade-offs.

The comic book itself is a good resource for third graders if they read at grade level or a little above. Write to the National Wildlife Federation* for prices.

3. Making the inevitable trade-offs and decisions.

The EME notebook*, Impacts — Activity 12, "The Kool-Aid Stand," is an experiment of some sophistication, requiring the class to prepare an environmental impact statement. Students consider all features of the proposed business that would affect the neighborhood.

Less complex ideas are suggested in Limits — Activities 5 and 6, "What Could You Do Without?" and "The Generous Garbage Man." See also the Department of Energy* "The Energy We Use, Grade 1," Activity 8, "Energy Conservation."

The problems of trade-offs and decisions can be approached without any other aid than the chalkboard by having students list the energy uses they have mentioned in previous activities or in other lessons. What would be the children's own priorities if they were obliged to reduce the amount of fossil fuel energy they consume? What trades would they make in order to keep the uses they most desire?

LIFE

1. Conservation starts with the individual in everyday life. No one is so young nor so old, so busy nor so privileged as to be exempt.

Activity XXI, "Make a Conservation Corner," pp. 26-27 in the Soil Conservation* booklet, *Teaching Soil and Water Conservation*, addresses this. As stated, this is "a place to exhibit many things that relate to the wise use of soil, water, grassland, woodland, wildlife, and mineral resources."

Another approach is offered in *Project Learning Tree**, "Classroom Conservation." This can be extended by using "Outdoor Classrooms on School Sites," Soil Conservation Service*.

Still another is for students to report personal experiences with water and energy saving, or other conservation practices in their own homes and in school as well as any recycling

accomplished during Soil activities above. The results might be shown graphically in a class-prepared mural, depicting all the conservation practices observed. Each student should sketch his favorite practice. The whole mural could be assembled and displayed in a conspicuous place in the school, or at least on the classroom wall.

In any class discussion of waste disposal problems and practices, you might wish to relate the true tale printed in *Save the Earth**. (See 3 Energy 1 above.) It is called "Taking Action — The Story of Mount Trashmore," and tells how Virginia Beach, Virginia, met a crisis.

2. We have a particular obligation to wildlife because we have taken so much of their territory. Children are likely to acquire a special appreciation of this as they develop sound wildlife management principles.

If you have not yet introduced your class to human responsibilities in this area of conservation, the points explained in "Helping Wildlife"* suggest several approaches. The film, "Island of Green," 26 minutes, obtainable from the Colorado Division of Wildlife Library* shows what happens in an area set aside as a natural classroom. It is a good introduction to wildlife habitat and an example of plant and animal interdependence.

Some schools have reproduced the experiment shown in the film — one was lucky enough to find a whole half acre that the class was permitted to fence. Other plots used successfully have been as small as 12 by 12 feet.

After seeing the film and discussing the establishment of their own wildlife preserve, students might write or draw their versions of the five basic requirements of habitat — food, water, shelter, space, and the proper arrangement of these four. Each child could select a species — mammal, reptile, bird, fish, insect — and discuss its needs in its natural environments. Let them conclude with their own versions of what people should do to conserve these environments.

RESOURCES
Grades 4-6

Activities and teaching aids suggested here have been used in the classroom successfully, will be available at least through 1980, and are mostly free or inexpensive. Each resource is keyed to its corresponding topic or goal in the "Strengths and Needs" instrument. Usually more than one resource is cited so teachers will have a choice of style or content for different grades within the 4-6 range. All materials fit into regular instructional programs; this is not a new or additional course.

A list of agencies and institutions that offer extensive printed and audio-visual matter in their own conservation specialties is appended for those who wish additional aids.

Throughout the "Resources", an asterisk (*) marks the names of all sources for more than a single recommended teaching aid or strategy. For example, the Soil Conservation Service is a prolific resource. The asterisk beside its name means that the address and other necessary details are carried in an alphabetical list, Appendix A.

Outdoor Biology Instructional Strategies (OBIS*) will be found useful in many areas where the Model does not specifically mention them. The complete set is becoming available commercially as it is written, but information concerning prices and where to get the material will continue to be obtainable from the originators by writing to OBIS, Lawrence Hall of Science, University of California, Berkeley, CA 94720.

"The Strand Approach," which was developed by the National Park Service*, uses five universal concepts or "strands" for outdoor environmental education, often helpful in all phases on which this Model touches. The five are: (1) variety and similarities, (2) patterns, (3) interaction and interdependence, (4) continuity and change, (5) evolution and adaptation. These are available from rangers and naturalists assigned to visitor centers in U.S. National Parks and Monuments*. They have been republished in *Exploring Your Environment**, suitable for grades 4-6, by Silver Burdett, 250 James Street, Morristown, NJ 07960.

Concept 1

Grades 4-6

THE WHOLENESS OF EARTH'S SYSTEMS

Understanding the Biosphere

1. **Earth, born as a ball of flaming gases flung off by the sun but kept under its control, went through many transformations. As it cooled and solidified and received its deluge of water, land masses heaved and shifted into the present pattern of continents and islands, mountains and valleys.**

2. **Life seems to have first appeared in the oceans and spread to land.**

"The Earth, Our Home in Space," a comic book in the Soil Conservation Society of America's* *Better Environment Booklets,* covers both topics with suggested discussion and activities. Ask your local U.S. Soil Conservation Office if it has copies. If not, write SCSA*.

For supplementary reading in Grade 6 and good readers in Grade 5, use *The Sea Around Us* by Rachel Carson, pp. 28-30 or *Peter Freuchen's Book of the Seven Seas,* pp. 21-23.

3. **The interplay of similarities and differences within nature is the key to the characters of Earth's ecosystems.**

*Project Learning Tree** demonstrates the point through these lessons: "Patterns in Nature," "Tree Shapes, Natural and Unnatural," "The Closer You Look," and "Branching Out." For a continuing demonstration, see the Soil Conservation Service*, *Teaching Soil and Water Conservation, A Classroom and Field Guide,* Activity XXI, "Make a Conservation Corner."

The idea can be reinforced, or even discovered, during a creative writing lesson. For example, show the film, "Adventures of a Junior Raindrop" (free loan from Cromar's Audio Visual Center* or Colorado Division of Wildlife*) if the class does not remember it from an earlier grade. Have each student write an original adventure, a paragraph to a page, taking Junior to any part of the water cycle — as a flake of snow falling on a glacier, disembodied in a cloud, a drop in a drink or the ocean, etc. The class might put their adventures together into a story, not changing the compositions but simply to string them together with such phrases as "Then Junior went on to ..."

It should not be surprising if someone puts Junior through the digestive tract or into a sewer; he always gets out, and will have demonstrated "unity in diversity."

WATER

1. All the water originally was fresh. Salt and other minerals washed into it from the land, a process still going on. In places where seas evaporated, salt and other deposits were left on the land.

By boiling a little salt water in a test tube or shallow pan, students can see that a deposit is left. Or a student might collect a sample of water runoff in a street gutter after a heavy rain, and evaporate that, so the class can see the residue. Discuss how runoff from all over the country eventually brings minerals from Colorado into the sea.

See *Captain Hydro**, pp. 12-13 of the "Student Workbook and Teacher's Guide." An activity in which students demonstrate the way oceans acquire the minerals is described in *Elementary Science Discovery Lessons, the Earth Sciences,* pp. 244-246. This book, although out of print, is in many school libraries.

1A. This reinforces and amplifies what may have been learned about the hydrologic cycle earlier. (See K-3, 1 Water 1.)

Students, perhaps with the teacher's help, might construct a model to demonstrate the water cycle. For example: They paint marks on the banks of a miniature pond to show how water leaves it by evaporation and runoff. They connect the runoff to a waterwheel that will drive moisture into clouds made of cotton (or a student diverts it into the cotton by hand if the waterwheel does not work well). "Clouds" are kept suspended over the pond until water drips from them.

An alternative is *Captain Hydro**, pp. 14-15 in both "Student Workbook and Teacher's Guide." Schools that have the Rand McNally SCIS* kits may wish to use "The Water Cycle," in "Ecosystems Part Two," pp. 42 of the Teacher's Guide.

2. Falling water affects the land, the effects varying with the amount and intensity of the precipitation.

A standard classroom experiment is to line two shallow boxes 8 by 12 inches or so with foil to make them waterproof. Cut a notch at one end, then place a rectangle of sod in one and bare soil in the other. Tilt them slightly so that the notched end is lower and just over an empty glass jar. From a sprinkling can, pour water on the two surfaces; the simulated rain will wash some of the bare soil into the glass jar; the water will soak in or run off the sod, leaving that jar almost clear.

An outdoor experiment, is described in the Soil Conservation Service's* Activity XIII, "Make Splash Boards to Study Splash Erosion" in *Teaching Soil and Water Conservation,* p. 16. (One does not need to stake out the boards and wait for rain. The same effect can be achieved with pieces of clean white cardboard about 8 by 12 inches. Have a student hold the cardboard in positions described for the wooden boards and splash water from a sprinkling can or by hand from a bucket from about the height of your shoulder.)

Alternatives are *Project Learning Tree**, "Rainfall and Forest" and "Holding Power."

3. Flowing water affects the land in equally important ways.

The "soakability" of land is a key point in determining what it will grow.

One device to demonstrate this point is a "coffee can infiltrameter," which is simply a couple of empty cans, coffee or juice or the like, with tops and bottoms removed. Press one of them an inch into a well trodden path or hard running track. Place the other in the same manner in a lawn or under well-tended bushes. Pour a cup of water into each and have

students note how long it takes the water to soak in — you probably won't want to wait until the can in the hard earth is empty. (You might wish to mention that the device was developed and named by cattlemen for practical use on the range. It tells them which areas are being overgrazed or trampled too heavily. It also shows farmers which soils need additional organic matter.)

Alternatives are *Captain Hydro**, pp. 18-19 in both the "Student Workbook and Teacher's Guide;" *Project Learning Tree**, "Why Do Trees Grow Here?"

AIR

1. Air's composition and qualities — the gases in it, the way it moves, its weight — are vital environmental factors.

One way to demonstrate the composition of air is to prepare a graph of what air contains — oxygen, nitrogen, carbon dioxide, inert gases, moisture. Movement can be demonstrated by releasing a very small amount of perfume from an atomizer in one corner of the room and have children raise their hands when the scent reaches them. Weight can be shown by filling two small balloons, one with very dry warm air and one with moist cool air. Observe which rises faster.

An alternative for schools that have the Rand McNally SCIS* *(Science Curriculum Improvement Study)* kits is " 'Inventing' the Oxygen-Carbon Dioxide Cycle," pp. 69, of the Teacher's Guide for "Ecosystems."

2. Air pressure, flow and temperature are especially important in determining where rain falls, snow accumulates, and seasons change.

The comic book, "The Earth, Our Home in Space" (Soil Conservation Society of America*) provides a good starting point for discussion in its section on "Our Amazing Atmosphere." See also *Project Learning Tree**, "Plant Growth and Temperature" and the *We Can Help!** packet of U.S. fish and Wildlife Service, Guide No. 5.

SOIL

1. The composition of any soil depends upon the kinds of rocks that are its basic ingredients.

If students are not familiar with the process of soil formation (by weathering of rocks and decay of organic material), review activities suggested under 1 Soil 2 of the K-3 section of this Model. An activitiy such as *Project Learning Tree**, "Sow Bugs 'n' Soil" or "Soil Compaction" completes the lesson.

2. Only a relatively small proportion of the land has soils capable of feeding big populations.

One approach is with a discussion of what constitutes fertile soil capable of rich crop yields. Be sure students understand that among the main plant needs from the soil are nitrogen, phosphorus, potassium, water, and air. Have students locate the principal areas of high soil fertility on a wall map of the U.S. — the Ohio Valley, the Mississippi Valley, the Ojai Valley in California, etc. Then show pictures of a New England coastal farm. Does the soil quality of that farm explain the westward migration of early settlers? Also locate the fertile sections of Colorado. Compare them to the total area of the state, and discuss their influence on settlement.

For other ideas, see the *Project Learning Tree**, "Succession and Compaction," and *Goode's World Atlas**.

ENERGY

1. **The exchange and balance of energy in nature sets up Earth's many different climates, determining where seasonal changes will take place and what those changes will be.**

The comic book from the Soil Conservation Society of America*, "The Earth, Our Home in Space," explains this in the section, "What Makes the Earth's Weather?" After carrying out the suggested activities, a class might try its hands at drawing maps of the world's various climates. The actual teaching could be combined with the 1 Air 2 lesson above.

A short activity in the EME notebook*, Sources — Activity 5, "Energy From the Sun," has students conduct an experiment to show how the sun's heat is reflected or absorbed by different materials. In Limits — Activity 2, "What Is a Natural System?" students explore various natural energy cycles to discover what keeps them in balance.

2. **Energy storage in the form of coal, oil, and gas was a long, slow process which, for all practical purposes, makes these fuels nonrenewable.**

Sources — Activity 2, "Some Things Are Renewable and Others Are Not," in the EME notebook* introduces students to this subject, or they might research in reference books the reason coal, oil, and gas are nonrenewable.

If a field trip can be arranged to the Florissant fossil beds or the Dinosaur National Monument*, a class would gain further information about the geological processes that made these fuels.

3. **Other forms of energy exist — solar heat, geothermal, nuclear, wind, tides, even garbage.**

The EME notebook*, Limits — Activity 1, deals with "Search for Minerals." An excellent solar heat experiment follows Conversion — Activity 9, "Solar Collectors." An activity on the wind is Sources — Activity 7, "Windmills, Kites, and Gliders." For energy from garbage, see Impacts — Activity 12, "Bagasse."

LIFE

1. **All forms of life depend upon the four natural resources — water, air, soil, and energy — in some combination.**

Students can carry out such simple experiments as the following to prove life's dependence on the four elements. Seal one leaf of a potted geranium in dark colored paper so no light (energy) can penetrate. After four or five days, remove the paper, test the leaf for starch, and observe the other differences between it and leaves that received sunlight. Meanwhile plant any fast-germinating seeds, two or three in fertile soil and the same number in poor soil. Give both containers equal water, air, and light and observe the difference in growth. Similarly prepare a pair of plants, one watered every day and the other not at all; and a pair, only one of which is exposed to fresh air.

After these experiments, students might research plants that adapt to scarcity — the cactus that needs little water, lichen on bare rocks, mushrooms in the dark, aquatic plants completely under water.

Students also can be introduced to life's dependence on the four natural resources on a brief excursion such as the one outlined in *Ten-Minute Field Trips**, by Helen Ross Russell, pp. 141-146. See also, Soil Conservation Service's* "Outdoor Classrooms on School Sites." A more elaborate field trip, one that will be highly instructive about many features of the environment on which conservation education is based, was worked out by

Vic Jepsen of the Holly Hills Elementary in Cherry Creek School District and the staff of the Keystone Center for Continuing Education. It is a four-day camping trip for sixth graders, during which the students carry on a variety of activities. Procedures, equipment, forms for parents to sign, a detailed calendar for each day, and other helpful data are contained in a brochure, "Beyond the Classroom," of which copies are available from Keystone Center for Continuing Education, Environmental Education, Box 38, Keystone, CO 80435.

2. **Through photosynthesis, plants manufacture the proteins and starches that sustain them and make them the basic renewable resource to feed and shelter animals.**

A short and simple lesson in *Project Learning Tree**, "Sunlight and Shades of Green" leads to enlightenment about the process of photosynthesis. Follow with "Building an Ecosystem." An excellent one-page graphic explanation will be found at the end of the EME notebook*, Sources — Activity 4, "Our Mr. Sun."

For teachers who wish to carry the idea further, see "Trace the Origin of Things We Use," Activity XIX, p. 24, in the Soil Conservation Service*, *Teaching Soil and Water Conservation*. This gives students another view of the importance of plants.

3. **Plants and animals in every ecosystem live as an intricate web of strong competition and profound interdependence.**

One way to introduce this is to quote Charles Darwin's remark that England's supply of beef depended on maintaining the old maid population. Can students trace the connection? (Old maids in Darwin's day kept cats; cats kept down the field mice which ate bumblebees which pollinated the clover upon which British cattle fed.)

Even more fun but requiring a little more time is a card game entitled "Predator," which the whole class can play. They learn which form of life eats what other form or (if plants) make their own food. Obtainable at $4.50 plus 50 cents shipping charge from Ampersand Press, 2603 Grove St., Oakland, CA 94612, discount rate for a dozen or more decks given on request.

Another resource is *Project Learning Tree**, "Web of Life" in which each student researches a forest animal (mammal, bird, insect, reptile) and the class produces a mural illustrative of life's interdependence within life-support systems.

4. **Wildlife in its natural habitat illustrates this competition and interdependence of living things, as well as the ways in which nature regulates population growth.**

*We Can Help!** contains (pp. 15-29) five wildlife survival games that are highly instructive on this point in terms of deer, fox, duck, eagle, and squirrel. See also "Helping Wildlife,"* the sections on the ways of nature, pp. 1-5, and population dynamics, pp. 13-16.

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Concept 2

Grades 4-6

THE EFFECTS OF ECOSYSTEMS ON HUMAN BEINGS

Understanding Human Dependence on Nature

1. Every environment has its own particular impacts and influences on the life styles of the people who inhabit it. Culture is in many ways a product of the ecosystem.

*Project Learning Tree**, "Folklore," and "The Native Way, a Natural Lifestyle" offer leading suggestions. An alternative would be a field trip, such as the one described in *Ten-Minute Field Trips** by Helen Ross Russell, pp. 94-95. It deals with succession, which could be followed by discussion on the human succession. "Outdoor Classrooms on School Sites" (Soil Conservation Service*) with imagination can be related here.

Without leaving the classroom, students might examine the effect of the environment upon their own community. Was it originally a farming, ranching, mining, trading, or railroad center? What physical features of the area determined this? The study could continue, if desired, with changes since the original settlement.

2. People learned to adapt to their environment long before they could modify it.

"An Outline for Teaching Conservation in Elementary Schools" (Soil Conservation Service*) in its page for Grade 5 deals with the influence that the ecosystem has on our way of life.

Alternatives are *Project Learning Tree**, "Woven History," "Native American Dwellings," and "Musing on Music."

The ways in which the original settlers adapted to the environment, if studied in connection with #1, would be a further demonstration.

3. Even after we have learned to modify the environment, we remain subject to the laws of nature.

The EME notebook*, Sources — Activity 4, "Our Mr. Sun," leads up to this as students discover how much of their life is governed by the sun.

WATER

1. Although we can and do redistribute the water of entire river systems (the Colorado, for example), the amount and timing of the precipitation that supplies the rivers are outside human control, thus limiting our activities.

*Project Learning Tree**, "Rainfall and the Forest" makes the point about water in the life

of trees in a way that could lead students to apply it to human activities. See also "I'd Like to Visit a Place Where." *Captain Hydro** deals with this on pp. 8 and 9 of both the "Student Workbook and Teacher's Guide," and page 6 of the "Teacher's Guide Supplement."

2. The effects of such devices as cloud seeding have so far been debatable.

*Captain Hydro** handles this on page 12 of the "Student Workbook and Teacher's Guide." The problem may also be demonstrated by student role-playing with the class arranged like this — each letter represents a child.

A = a rain cloud (a role preferably for a short child with a lively sense of humor). **M** = mountains (children standing). **G** = Grand Junction and **D** = Denver, both represented by children seated. **A** is being blown east and should act out the state of being full of moisture, so full that the wind cannot lift the cloud over the Continental Divide. Therefore, the cloud must release rain or snow before getting above all those Ms. The cloud seeder may speed this process a little, but does he create more rain?

3. Colorado's major watersheds depend far more than those of most other places on snow's spring melt rather than rain. The amount of precipitation varies widely. The high mountains get most.

One way to start is to have the students determine the number of major watersheds in Colorado. A watershed map of the State is available from the Soil Conservation Service*. As a class project, students might construct a relief map of the State to show the major watersheds and where each major river flows. The map of the watersheds and a map of rainfall, which will show the heavy precipitation in the mountains, demonstrate why most of Colorado's water comes from snow melt.

4. Unpredictable qualities of the hydrologic cycle force us to allocate and conserve water.

*Captain Hydro** on pp. 22-24 of the "Student Workbook" and pp. 21-23 of the "Teacher's Guide" offer ideas. The general principle is that "water does not grow in a faucet" and students discover the impact of all the "usual" things that can happen to the water cycle.

AIR

1. Very hot air and very cold air severely restrict human habitation.

2. Elsewhere the air may have either good or bad effects on people — the steady trade winds, violent storms, gentle breezes, uncomfortable temperature inversions.

The geography textbook should cover the different cultures that evolved in very hot and very cold climates. If not, the facts can be conveyed by slides or pictures of Arctic and equatorial peoples.

The class might research trade winds as against violent storms, temperature inversions and gentle summer breezes. A field trip to the Great Sand Dunes in the San Luis Valley reveals another example of what air can do.

For this aspect of air's importance, and for all others to be dealt with in this Model, a trip to the National Center for Atmospheric Research (NCAR*) in Boulder is very valuable. This is one of the world's leading research centers, sponsored by the National Science Foundation and operated by a consortium of more than 40 U.S. universities. It invites pre-

arranged student tours, but discourages children below the fifth grade on the ground that they are more confused than informed by the tour, which includes film showings and a guided tour by a specialist who has had experience with students of all age levels on the trip. Application at least two weeks in advance is required, more if possible; the days for tours are Tuesdays, Wednesdays, and Thursdays during the school year.

3. **Air as a carrier of dust and pollen helps maintain plant life.**

Students might be asked to bring to class seeds that are carried by the wind — dandelion puffs and the "cotton" of cottonwood trees in the spring are the easiest — and plants that rely on wind to bring pollen from one flower to another.

Help students discover not only that the air takes material from one piece of land but that the wind gives that material to another site.

SOIL

1. **Soil quality can foster or destroy a civilization.**

The point can be made by showing pictures of the Nile bringing its annual deposit of rich soil to Egypt before the Aswan Dam was built, of farmers working a stony field, of the Missouri River in one of its peak floods burying rich farmlands under a dozen feet or more of infertile clay and gravel, of U.S. farms abandoned after the fields were "worked out" (the soil nutrients exhausted). Discuss how much the culture in these places owed to nature rather than to the people's own efforts.

Alternatives are The Soil Conservation Service* pamphlet, "Conquest of the Land Through 7,000 Years," or the Soil Conservation Society of America* comic book, "Land, Its Use and Misuse Through the Ages."

2. **The slow process of soil formation severely limits areas suitable for the intensive cultivation upon which large modern populations depend.**

The process of soil formation can be demonstrated in the classroom by a series of experiments such as is described in Activities I and V, *Teaching Soil and Water Conservation* (Soil Conservation Service*). Another resource is *Project Learning Tree**, "What's in Soil?"

3. **Soil supplies the nutrients for plants and the support for their stems.**

One experiment that shows the nutritional needs of plants is to burn a few leaves in a pan, mix the ashes with a little water, evaporate the water and have students observe the residue with a magnifying glass. They will see some of the minerals that the plants absorbed from the soil in which it grew. See also The Soil Conservation Society of America* comic book, "Plants, How They Improve Our Environment."

ENERGY

1. **The limited, nonrenewable nature of fossil fuels and metals causes people to settle in places and resort to expedients that are often unpleasant.**

Students probably can find in newspapers and magazines pictures of the expedients to which we resort in our search for fossil fuels — examples as the frozen work camps at the northern end of the Alaska pipeline, drillers in the North Sea, power plants with their villages for workers in remote deserts, mining towns in desolate areas. Discuss the reasons why work in many of these places is often by short-term contract. The EME notebook*, Uses —

Activity 9, "Our Leisure Time Activities," has a section that deals with this problem.

2. **The search for new reserves of fossil fuels, for alternative renewable energy sources, and for substitute minerals and synthetics also has its impact on human life styles.**

In *Project Learning Tree**, "Can You Dig It?" students face the possibility that we might have to alter some features of our daily routines. See also the EME notebook*, Uses — Activity 9, "Our Leisure Time Activities."

LIFE

1. **Each of Earth's ecosystems developed animal and plant life that helped to shape the particular culture that evolved there.**

From pictures of life among Eskimos, American Indians, Africans, and desert tribes, for example, students can identify the plants and animals that provide distinctive features of the particular culture, such as furs, bone tools, and skin boats for the Eskimos. Helpful in the discussion might be three graphs from the Audubon Society* — "Forest Food Chains," "Salt Water Food Chains," and "Amphibians."

2. **Colorado has abundant examples of how cultural diversity develops.**

This might be taught as an elaboration of the local activity suggested for 2 Understanding 1 & 2 how people learned to adapt to the environment. The Mesa Verde Indians and their unique dwellings are an example. But the changing life styles as the patterns of any settlement changed could be studied to discover how people from different backgrounds reacted to Colorado's ecosystems.

Concept 3

Grades 4-6

HUMAN BEINGS ARE NOW THE MOST INFLUENTIAL OF EARTH'S ORGANISMS

Understanding Human Impacts on the Environment

1. People developed their ability to change the environment by exploiting natural resources as no other form of life does.

Some teachers have students list things with which they are familiar that have been changed from nature, and also the natural resources involved such as:

A parking lot — soil and energy
Hot water heater — water and energy
An air conditioned room — air and energy

The EME notebook* offers another approach in the activities under the second Sources' Concept: "Access to energy sources affects the growth of differing technological, social, governmental, economic and cultural systems." See also Limits — Activity 3, "The Word 'Limited'."

2. While man-made changes in ecosystems grew throughout recorded history, the acceleration in this century has been unprecedented.

The EME notebook*, Uses — Activity 7, "Toys — How Many Do We Need?" puts the point in terms of children's own belongings. A shorter activity not covering as much ground is Uses — Activity 10, "Things I Like to Do."

3. A review of the human qualities that made this possible is desirable.

The items mentioned in #1 or similar ones that you suggest might be a start — an indoor swimming pool, for example, and a winter coat. What enables us to get these things when animals have to make do with nature's swimming holes and grow their own winter coats? A review of 3 Understanding 1 in part of the K-3 section of the Model may be helpful.

WATER

1. The water of major watersheds has been distributed artificially to supply people's wants — arbitrarily as far as other forms of life are concerned. Recently some of our decisions include provision for wildlife.

*Captain Hydro**, "Regional Teacher's Guide Supplement," and pp. 16-17, of both the "Student Workbook and Teacher's Guide," offers one approach. Others are in the EME notebook*, Impacts — Activity 18, "Water Pollution;" The Rand McNally SCIS* kit, the "Ecosystems" teacher's guide, Part Five, p. 82, "Pollution" may prove helpful.

For a positive aspect of human intervention, the film, "The Wetlanders," 25 minutes narrated by Bing Crosby, might be shown. It shows how people restored a wetland on which ducks depend. It is on loan from the Divison of Wildlife*.

2. **Whether we preserve and improve water quality as we use it or degrade and pollute it has a major impact on us as well as on plants and animals.**

Suggestions are contained in *Captain Hydro**, pp. 22-24 of the "Student Workbook" and pp. 21-23 of the "Teacher's Guide;" *Project Learning Tree**, "Water You Know?" and in the Rand McNally SCIS* kit's section, "Pollution," noted in the preceding paragraph.

Still another resource is the Check Dams section, pp. 68-71, in "Help for a Better Environment," available from Keep Colorado Beautiful* but prepared and copyrighted by the Lakewood Environmental Group of Denver.

AIR

1. **We must accept our air in the condition supplied by the ecosystem, but we do not always leave it that way.**

2. **Man-made air pollution can damage human lives and property. It also affects other forms of life.**

These two topics are covered as one in the Rand McNally SCIS* kit section "Pollution" as noted in 3 Water 1 above.

SOIL

1. **Soil, like air and water, can be preserved or damaged according to the way people use it.**

"An Outline for Teaching Conservation in Elementary Schools," the page for Grade 6 (Soil Conservation Service*), offers suggestions, as does the same agency's *Teaching Soil and Water Conservation*, Activities X, XI, and XII, "How Does Crop Cover Affect Soil Loss?," "How Does Mulch Prevent Soil Loss?," and "What Does Contouring Do?" See also the EME notebook*, Impacts — Activity 3, "To Fertilize or Not to Fertilize."

2. **The uses to which we put the soil also changes much of the natural environment whether what we do is farming, grazing, lumbering, mining, urbanization, transportation, or recreation.**

The subject can be dealt with in its broadest aspects, or confined to a view of the local community.

*Project Learning Tree**, "My Use or Your Use or Our Use," and the Soil Conservation Society of America* comic book, "The Story of the Land, Its Use and Misuse Through the Centuries and Today," contain valuable strategy suggestions.

ENERGY

1. **Extraction of fossil fuels, minerals and metals has had a major impact on agriculture, forests, native plants, and wildlife.**

The EME notebook*, Uses — Activity 14, "Industry vs. Environment — Who Wins?" and *Project Learning Tree**, "Forest Consequences," contain useful ideas. Or students might research the effect of any mining operations, past or present, on farming,

ranching, and wildlife in your area. This might be combined with the local investigation suggested in the next topic.

2. Our accelerated consumption has brought us within measurable distance of the end of these resources.

The EME notebook*, Limits — Activity 3, "The Word 'Limited'," is a good introduction. See also a polular *Ranger Rick** comic book, "The Best Present of All," available from the National Wildlife Federation* — first copy free; additional copies, 15 cents each; in bulk, 12 cents each. It is the story of a benevolent king seeking to find the best energy source for his people, and after interviewing them all, he opts for the sun.

Examples of the consequences of extraction, positive as well as negative and not only in connection with wildlife, can be found near almost every Colorado community. Students may profit from combining this with the wildlife research suggested above.

LIFE

1. Human impacts on the environment in industrialized societies often determine which species of plants and animals flourish or survive and which decline or vanish.

This has been partly covered in Energy above, but other aspects that do not deal with mining are important. An example, is shown in the seven minute film, "Where should a Squirrel Live?," about a baby squirrel adopted by a human family and then released to the wild. It is a good springboard for discussion of the human impact on native wildlife not connected with extraction of fuels and minerals. A supplementary illustrated reading is "A Plant Called Joey Answers Some of the Questions," pp. 14-15 of *A Child's Garden*, Ortho Publishers. The *We Can Help!** packet, Guide No. 2, has another approach. It calls on students to construct a model of a land area and a mini-dam.

2. Wilderness and wildlife management in Colorado illustrate one phase of the human impact on the environment.

The section on what wildlife managers do in "Helping Wildlife,"* p. 21, stimulates student investigation of wildlife and wilderness management in Colorado. If in the Denver area, you may borrow the slide show "Wildlife in Colorado" from the Wildlife Division Library* (must be picked up and returned). See also the bilingual booklet *Game Animals of Colorado* from the Division of Wildlife*, If the district wildlife manager of your region is speaking at the school, ask him to explain hunting and fishing regulations. If students draft a questionnaire to circulate among families and friends, they can get some idea of the importance of hunting and fishing as recreational activities. A parent who is also a hunter might speak to the class about his experiences. Good background for teachers is the Division of Wildlife* book, *Today's Strategy...Tomorrow's Wildlife*, 96 pages, available for $3.00.

3. Every community in Colorado is a clear example of how the development of our life styles generally affected the ecosystem.

A series of "then and now" pictures of various cities, towns, recreation areas, farms, mines, and ranches could demonstrate this, followed by a series of your own communit . Students might write a short essay on what they like or dislike about the change. To what feature of people's life styles do they attribute the change, whether they approve or disapprove? An alternative would be a discussion or brainstorming session in which students try to reach conclusions on which changes are positive and which are negative.

Concept 4
Grades 4-6

OUR ABILITY TO COMPREHEND MUST BE COUPLED WITH THE OBLIGATION OF SELF-CONTROL

Understanding Human Responsibilities and Opportunities

1. **Conservation means the wise use of resources.**

The film "Water Follies, a Soak Opera" (See 4 Water 2 in K-3.) is a good introduction to conservation needs and practices. Other useful activities are described in *Project Learning Tree**, "Memory Circle." The activities should prepare students for actual conservation practice on their own.

2. **The benefits of Earth's natural resources can be extended by the practice of conservation, socially and individually.**

One way to discover this truth is through a study of the history of conservation in the world, or at least in the U.S. An informative aid is the Soil Conservation Society of America* comic book and teacher's guide called "Pioneers." Another good resource directed toward the same end is in the same series, and is titled "The Idea That Worked." Students might look up who the leaders of conservation in Colorado have been, and report to the class on them and their accomplishments.

3. **Although conservation means different things to different people, it may be useful to try to reach agreement on human responsibilities.**

Suggestions are contained in "Help for a Better Environment," a brochure prepared by the Lakewood Environmental Group. It is available from Keep Colorado Beautiful*.

Another approach is to have students name four or five natural resources that they think should be conserved in their area. With these listed on the chalkboard, the class might be able to reach through general discussion a consensus on the desirable priorities. An alternative involving less argument is outlined in "Take a Field Trip," EME notebook*, Impacts — Activity 4.

WATER

1. **Water priorities are set through popular or governmental decisions on supplying competing claimants — agriculture, cities, industries, flood control, transportation, recreation, wildlife.**

*Captain Hydro**, pp. 6, 7, 10, 25 of the "Student Workbook" and pp. 6, 7, 10, 24 of the "Teacher's Guide," offers one strategy. Children might find out by asking parents or others what are the major decisions concerning water supplies that face their community. Who are the competing users? How much does each want or need? Can the supply be stretched to cover all of them? Can the class reach a consensus on the priorities to be assigned?

As a practical demonstration of both the priorities and what is involved in actual conservation, the class might undertake a water-saving campaign, such as is outlined for Grades K-3 in 4 Water 1.

2. **Increasing demand on limited supply decrees that each priority granted involves a trade-off, sacrificing or diminishing another use of water.**

The film "Water Follies, a Soak Opera" deals with this (See 4 Water 1 above.) and so does the Soil Conservation Society of America* comic book "The Wonder of Water." If the class started a discussion of this subject in connection with #1 above, they might resume it here.

3. **In these decisions, non-polluting uses, purifying practices, and re-use become increasingly important.**

*Save the Earth**, by Betty Miles, in the section "Water," pp. 55-75, tells in the story, "Taking Action," how the sloop *Clearwater* and its crew are doing something about cleaning the waters of the Hudson River in New York State in some of its most beautiful stretches. (It costs $2.50 from Alfred A. Knopf, 201 E. 50th St., New York, NY 10022.)

An activity in which students consider the problems of saving a marsh from extinction is available from the Audubon Society*. It is one of the Audubon Nature Bulletins, and is called "Reed River Decides, The Story of a Marsh." It involves cutouts of material supplied on a single large, poster-size sheet. Another resource is the water activities in "Help for a Better Environment" supplied by Keep Colorado Beautiful*.

In all activities dealing with water conservation, you may want students to pay particular attention to the many re-uses — from putting the water in which Mother cooked the vegetables on a flower bed to the irrigation of farms with water from a city sewage filtration plant.

AIR

1. **Current practices that pollute the air pose another set of problems and conflicts: A. motor vehicle emissions; B. industrial emissions; C. heating dwellings; D. burning waste.**

An Audubon Society* Nature Bulletin, "Our Threatened Air," deals with this point using specific examples from various parts of the country. Two activities on particular phases of air pollution are in the EME notebook*, Impacts — Activities 1 and 2, "The Automobile," and "The Air Yells 'Help!' ". The section, "Air," pp. 33-35 in *Save the Earth* (See 4 Water 3 above.) is an alternative.

2. **Costs and trade-offs are involved in reducing or preventing air pollution.**

Helpful ideas will be found in the Department of Energy*, *Interdisciplinary Student/Teacher Materials in Energy...* prepared by the National Science Teachers Association, the draft volume on "Energy and Transportation." Although labelled for Grade 3, it contains activities sophisticated enough for students up to Grade 6. Included are problems and trade-offs involved in the solution of perhaps the most abrasive of air pollution issues, the automobile. *Save the Earth** on air (mentioned in the preceding paragraph) is useful in pursuing this study. Also *Project Learning Tree**, "How Clean Is Clean?" in the Grades 7 to 12 volume speaks of this.

SOIL

1. **People's responsibilities for soil conservation lie in wise use and management of the land whether for farming, forest, wilderness, mining, urbanization, recreation, or anything else.**

For this subject generally, *Project Learning Tree**, "Improve Your School Site" is a practical exercise. A film, "The Last Frontier," 22 1/2 minutes, is the story of the Bureau of Land Management*, from whom it is available.

It is also available from the Wildlife Conservation Library, Division of Wildlife*.

2. We face other responsibilities when alterations in land use are contemplated, as:

A. Changing forest, marsh, or grassland to cropland or reservoirs;

B. Converting prime farms into sites for buildings, highways, etc.

*Project Learning Tree**, "Changing Land Values" is a springboard to this topic. Other resources are the "Land" section, pp. 11-31 in *Save the Earth** (See 4 Air 1 above.) and the Soil Conservation Service*, *Teaching Soil and Water Conservation*, Activity XVI, "How Does Fertilizer Affect Plant Growth?" "Outdoor Classrooms on School Sites" (also Soil Conservation Service*) can be applied.

A great many Colorado communities face problems of land use, and students discover the conservation issues involved if they research the pros and cons of such a local issue.

ENERGY

1. The more we deplete nonrenewable sources, the more important conservation becomes.

The EME notebook*, Sources — Activity 1, "Energy Sources and Measurements," is a crossword puzzle game on this topic. Conversion — Activity 7, "Elements of a Good Life," pursues the subject in a simulation game that sets teams of students working on one of five aspects of "the good life."

2. Differences in conservation principles are demonstrated by wise and unwise uses of energy in the local community.

The first task for the class often is to decide which energy uses are wise and which are unwise. Students may work out a satisfactory list by brainstorming and then using the results to survey their own consumption. As a practical demonstration of a switch from unwise to wise uses, the class might enter into a competition to see who can save the most.

3. Problems of priorities and trade-offs arise.

This might be taught in connection with the air and water priorities and trade-offs. For energy conservation in this connection, see the EME notebook*, Future — Activity 3, "The Choice is Yours." The Uses section has special activities on paper, personal conservation, electricity, appliances, recycling, and trade-offs, and the Impacts section has activities on waste. The strategy used should help students reach their own conclusions.

LIFE

1. **The stakes in conservation of natural resources are the growth of cities and industry, the productivity of agriculture, our enjoyment of leisure, the preservation of wilderness and wildlife, and the well being of future generations of all living beings.**

Such issues are faced when National Parks or Monuments are established. Enos A. Mills, who is regarded as the founder of Rocky Mountain National Park, wrote extensively about America's natural beauty and resources. His books, documents, and photographs associated with the establishment of one of America's great National Parks have been preserved with Enos A. Mills Homestead Cabin* near Estes Park. School tours, including field studies, can be arranged and are encouraged.

One successful teaching device has been to divide the class into teams, one each for urban growth, industrial expansion, agricultural productivity, recreation, wilderness, and wildlife, and the needs of the future. Each team drafts its own reasons why the wise use of water, air, soil, and energy are essential to that particular section of our world. The statements can be circulated or read or a debate staged on priorities and trade-offs.

The topic is sometimes taught in terms of a single aspect of conservation. If industry is the choice, see EME notebook*, Uses — Activity 14, "Industry vs. Environment — Who Wins?"

2. **Opportunities for students to promote and practice conservation exist in school, home, and local community.**

Students might review what they actually have accomplished in the way of conservation during an earlier part of the school year, making a score card of savings of natural resources or conversions to wise use for which they should be credited. Such headings as these have been used.

Water
Electricity
Gasoline
Heating Fuel
Littering/Recycling

Students working as teams, one for each category, could write newspaper reports or draw and paint murals for school display. Opened up shopping bags pasted or taped together emphasize the principle of re-use. In some communities, it also has been possible for students who recycled enough waste paper, bottles, cans, and other scrap to finance a class party.

For further suggestions, consult *It's Your Environment: Things to Think About, Things to Do*, Charles Scribner's Sons, 597 Fifth Avenue, New York, NY 10017. The book contains many action-oriented conservation ideas for school and home. The hardbound copy price is $7.95, paperback $4.95.

RESOURCES
Grades 7-9

Activities and strategies suggested in the following pages are designed primarily to stimulate the imagination although they have been successfully used in the classroom to teach topics listed in the "Strengths and Needs" instrument. But teachers are encouraged to use modifications or substitutions to meet the specific needs, interests, and experiences of their classes.

Resources are keyed to the corresponding items in the "Strengths and Needs" by number and symbol. Two or more resources usually are given, different in content but of suitability for various subject areas.

The authors' suggested use of a resource should not be considered mandatory. Science, language arts, and social studies predominate, but materials noted here are also suitable for inclusion in courses on art, mathematics, music, foreign languages, everything. All suggestions are designed to fit into an existing curriculum. Inclusion in lessons already scheduled rather than as separate lessons strengthens the enriched content as well as conservation.

For those who wish additional aids or information, the appendix contains agencies and institutions that offer extensive printed and audio-visual matter in their own conservation specialties.

Throughout the "Resources," an asterisk (*) marks the names of all sources for more than a single teaching aid or strategy. For example, the Soil Conservation Service is a prolific resource. The asterisk beside its name means that the address and other necessary details are carried in an alphabetical list, Appendix A.

Concept 1

Grades 7-9

THE WHOLENESS OF EARTH'S SYSTEMS

Understanding the Biosphere

1. Year after year the world's many ecosystems operate within the framework of their special characters through the interplay of forces that include:

A. Earth's rotation on its axis at a constant speed;

B. The tilt of that axis at 23½° from perpendicular to the plane in which Earth rotates;

C. Earth's orbit around and distance from the sun;

D. Prevailing winds and atmospheric pressures.

A start might be to demonstrate what would happen if the Earth's axis was perpendicular instead of tilted. One simple method is to pass a small globe around a lamp at roughly the 23½° tilt while the class observes how the light strikes different parts of the world. In the same orbit with the globe perpendicular, light falls on the Earth's surface the same all the way around. If the world really revolved in this way, it would have no seasons and all days and nights would be the same length.

A class research project is another approach. Teams consisting of about one-sixth of the class might each investigate the effects of: Earth's rotation, the tilt of the axis, the orbit around the sun, distance from the sun, prevailing winds, and atmospheric pressure. In whatever form the teams report, they should include the relationship of these forces to each other.

A field trip and classroom activities such as are suggested in "Solar System," pp. 131-137 of *Ten-Minute Field Trips**, by Helen Ross Russell might also be undertaken.

2. The upheavals and subsidings of Earth's crust before it reached its present conformation created distinctive environmental features. E.g., Colorado was ocean bottom at least three times.

A reading in any standard Earth Sciences text will supply the basic information. *Prairie, Peak, and Plateau: A Guide to the Geology of Colorado**, prepared in color for Colorado Geological Survey at a cost of $4.00 has a concise account. See also *Geography of Colorado** by Joy Clapp and Paul Stevens, p. 12-15. From their reading, students might draw maps of the State showing the location of sedimentary, igneous, and metamorphic rock layers.

Students can carry out their own experiments to demonstrate the formation and differences

of the basic rock types from rock samples.

3. **Many of these changes profoundly influenced life forms; most of those we know developed in the last few million years.**

Pictures of some of the living things that existed in different ages — the simpler forms followed by the more complex — can be effective. Changes in the pictured environments are as marked as changes in plants and animals. Dinosaurs and other huge reptiles are a case study that fascinates students as they explore the features of the ecosystem that fostered the development of these species, and what caused their extinction.

Schools that can arrange field trips to either Florissant Fossil Beds National Monument or Dinosaur National Monument may wish to take advantage of these unique formations to reinforce students' understanding of the development and disappearance of species. Write to the National Park Service* for a descriptive leaflet and to make an appointment for one of the officials to be present to explain fossils and answer questions.

See also the *We Can Help!** packet, Guide 24, "Endangered Species: Mystery Birds," and frames 18-28 of "The World of Endangered Wildlife," a National Wildlife Federation* filmstrip. This is on loan from the Division of Wildlife* and is accompanied by a Federation special issue *Endangered Species*, of which pp. 16-21, "Man Stacks the Evolutionary Deck," are relevant here.

WATER

1. **Water has a great equalizing effect on climate. Partly this happens because so much of Earth's surface is ocean. Another reason is inherent in water's properties:**

   A. **It condenses as it cools to a point, then expands as it cools further. Almost everything else continues to contract the colder it gets.**

   B. **Water can store vast amounts of energy (heat).**

   C. **Water is an almost universal solvent.**

Help students find features of the environment that would be different if water continued to contract like everything else as it cools. (At 4°C [39°F] water expands. The most obvious is that ice would sink to the bottom of bodies of water.) How much aquatic life would survive?

"Water as an Energy Source," Activity 5 in the Uses section of the EME notebook* for Grades 7-9, covers both the chemical properties of water, especially hydrogen, and energy storage. An alternative would be Guide No. 10, "Water Quality Analysis," in *We Can Help!**

2. **Aquatic life is especially important in Colorado. Significant variations in plants and animals occur in cold and warm waters.**

"Investigating Fishing" as published in *Environmental Respect** presents 20 pages of curriculum lesson ideas. It is available from the Safari Club International Conservation Fund, 877 S. Alvernon Way, Tucson, AZ 85711.

One way to start the study of aquatic life is to build and stock a balanced aquarium for the classroom. (A balanced aquarium is one that needs no food added to it, and so it contains both plants and animals.) For vivid illustrations depicting aquatic life that can be reproduced for classroom use, see "Fish Environments," Unit 2, Cooperative Extension Service, Colorado State University, Fort Collins, Colorado 80523. A film, "Still Waters," 13 minutes of life in a watery environment, is available from the Division of Wildlife*. A related activity would be to have the class map the aquatic wildlife resources of Colorado, birds as well as fish. The State has 106 fish

species, 36 amphibian and reptile species (not all reptiles are amphibian), an estimated 40 mollusk species, and about 200 crustacean species.

For outdoor classroom activities, see *We Can Help!** Guides No. 8, "Old Ponds and Young Ponds Succession" and No. 18, "Wetlands and Wildlife." A field trip to a pond, lake, stream, or fish hatchery could follow or accompany any of these activities. The district wildlife manager of your region can explain Colorado's aquatic resources and their management. If possible, arrange for a wildlife manager's visit in conjunction with several school classes.

AIR

1. The gasses of which air is composed are a key to all life. Each main constituent has special properties.

Experiments for determing the principal elements that compose air — nitrogen, oxygen, carbon dioxide — generally are described in science texts and require laboratory equipment. Another resource is EME notebook*, Conversion — Activity 3, "Evaporation-Condensation."

"A Lesson Plan Outline for Measuring Some Water Quality Criteria," is taught as a hands-on experience for those who attend the U.S. Forest Service Environmental Education Workshops. Write U.S. Forest Service*, Box 20727, Denver, CO 80225 for workshop dates.

Alternatively or as a supplement, students might observe the interchange in the balanced aquarium (1 Water 2). Fish inhale oxygen and exhale carbon dioxide while plants take in carbon dioxide and give off oxygen, at the same time using nitrogen as food. The value of nitrogen in this respect may be shown by adding a fertilizer with a high nitrogen content to the soil of a potted plant.

2. Air's weight is a major factor in the environment; water vapor is the heaviest component, but the others have weight, too.

A first step is to weigh a tire tube before and after it is filled with air. The expansion and contraction of air may be demonstrated with a toy balloon moderately inflated. Chilled, it shrinks; heated, it expands to the point of bursting. Air's moisture content often is obvious when a day of high humidity can be contrasted with one of low humidity. *Sun Earth*, by Richard L. Crowther, Chapter 1, "Energies," a well illustrated and well written discussion, offers other ideas, Charles Scribner's Sons, 597 Fifth Ave., New York, NY 10017.

3. Air renews itself through an intricate process. Living things are a part of it.

See 1 Air 1 above.

SOIL

1. All soils derive from one of the three basic rocks that compose Earth's crust — sedimentary, igneous, metamorphic.

Teaching strategies on the process of soil formation are described in Activities I and V in *Teaching Soil and Water Conservation* (the Soil Conservation Service*).

2. Nature has its own ways of maintaining and redistributing soil:

A. Plant cover and flat or gentle slopes keep soil in place.

B. Wind and water erosion move soil around, eventually washing it into the oceans.

C. Soil renews itself very slowly as

rocks wear down to particles and plant and animal decay adds major ingredients.

2A. The effects of slope or flatness is demonstrated in Activity XIV, "Measure the Slope of a Field;" and XV, "Measure Amount of Soil Loss," in *Teaching Soil and Water Conservation* (Soil Conservation Service*).

2B. The importance of vegetation in keeping soil in place is explained in Activity X, "How Does Crop Cover Affect Soil Loss?"

2C. An amplification of soil formation to show soil renewal is contained in Activity VII, "Find Out How Much Alive Soil Is."

The discussion suggested in the booklet might be expanded to consider how rock and other particles blown in or washed in combine with the organic matter to renew the soil. See also "Outdoor Classrooms on School Sites" (Soil Conservation Service*).

3. Colorado soils which are not held in place by land formation and slope, by forests, or by vegetation are susceptible to permanent loss. The washed away soils of Colorado are deposited in the Gulf of California and the Gulf of Mexico.

A map of Colorado's nine major river water sheds, will help students identify the area drained by the system in which your community is located. (If no such map is at hand, ask the nearest Soil Conservation Service office for a copy of "River Basin and Watershed Progress — Colorado" issued October 1, 1977. The watersheds shown are those of the Yampa, White, Colorado, Gunnison, Dolores, San Juan, Rio Grande, Arkansas, and Platte.) Students can calculate where soil eroded from their neighborhood would end up — Gulf of Mexico or the Pacific.

Geography of Colorado, Chapter F, p. 23, "Colorado — 'The Mother of Rivers,' " also has maps of the rivers.

ENERGY

An overall introduction to energy as it will be studied throughout this 7-9 section of the Model is provided in "Mickey Mouse and Goofy Explore Energy," a comic book produced by the Walt Disney Educational Media Company. It is obtainable free from Exxon in any quantity you need. Write Exxon, Public Affairs Dept., P.O. Box 2180, Houston, Texas 77001. In the course of their adventures in a car on the way to a fishing hole and in a dream, the pair cover the nature of energy, its sources, uses, scarcity or plenty, effects on the country, and the importance of conserving it.

The National Science Teachers Association has prepared for the Department of Energy* a 72-page volume, student/teacher materials for Grades 8 and 9, entitled "Mathematics in Energy." Issued in December, 1977, its seven activities deal with fractions, decimals, percent, and graphing. The book is free.

1. Energy is of two kinds, although the sun is the source of both. Kinetic energy is that which is manifest as either heat, light, or motion. Potential energy is that which is stored, as in food, fuels, batteries, the nuclei of atoms, water held behind dams.

2. The three types of energy sources are:

A. Continuous (solar, geothermal, tides, winds);

B. Renewable (food, wood and other growing things that burn);

C. Nonrenewable (coal, oil, natural gas, metals — which cannot be grown).

Ideas for introducing a class to kinetic and potential energy, along with the first two laws

of thermodynamics, will be found in Lesson 2, "Energy Converts to What? ...and Why?" in "Energy, Engines, and the Industrial Revolution," which is Volume 3 of "Interdisciplinary Student/Teacher Materials in Energy, the Environment and the Economy" produced for the Department of Energy* by the National Science Teachers Association. The lesson is in four parts, of which the first two apply to the kinds of energy and the sources; the other two parts are optional.

An alternative is suggested in the EME notebook*, Sources — Activity 6, "Which Fuel?" This involves student research to discover an ideal fuel, and requires them to report as individuals or in panels on various types of energy sources to prove the one they select is best.

Sun Earth (See 1 Air 2 above.) may also be useful — Chapter 1, "Energies;" Chapter 2, "Natural Energies;" Chapter 3, "Sun;" Chapter 4, "Wind/Air."

3. **Regardless of source, energy is never lost, only changed — first law of thermodynamics.**

4. **Conversions of energy from one form to another involves some loss of heat — second law of thermodynamics.**

Both laws of thermodynamics are presented in more detail in Lesson 3 of "Energy, Engines, and the Industrial Revolution" (Department of Energy*). Lesson 3, entitled "The Great Joule Robbery," concerns primarily "heat engines" such as gasoline, diesel, and steam. Students use a fact sheet, draw or build models, and carry out experiments.

The EME notebook* deals with this in three activities, Conversion — Activities 4, 5 and 6, "Energy and a Physical Change of State," "Liberation of Heat Energy" and "The Conversion Process." The first two are carried out as either student experiments or teacher demonstrations. The third consists of six experiments concluding with a written essay or test.

LIFE

1. **Each environment is hospitable only to those forms of life that can adapt to its particular climate, soils, air, and water. Plants and animals are still changing form in order to adapt.**

Colorado's many different environments, each with its characteristic forms of life, open up many possibilities for the teacher.

An art session might be devoted to student-created drawing of typical plants and animals from each of the state's major ecosystems — semi-arid plain, desert, well-watered valleys, high mountains, lakes, wetlands, streams, forests.

Or the class might name animals particularly equipped for their environment — webbed feet of frogs, teeth and paws of beaver, and so on — and write one page reports on any one animal the student chooses, paying particular attention to signs of adaptation that still go on. (Animals are still coming out of the water to live on land.) On a smaller scale, adaptation can be studied by means of insects, as described by Helen Ross Russel in *Ten-Minute Field Trips**. See "Insects and Other Anthropods," pp. 56-64. As she points out, these animals are small, cheap, easy to maintain, and usually odorless. They make nice classroom pets.

2. **Within each environment, an important feature of the adaptation is for every plant and animal to take its place in the web of life.**

Plants get their food from the soil, but all the rest of life feed on other forms of life. The relationship is established quickly in *Project Learning Tree**, "Predator Prey." This shows

how vegetation supports the deer on which the mountain lion feeds, with leftovers for scavengers such as coyotes. It is designed for mathematics or science classes. Or see pp. 1-4 of "Helping Wildlife,"* by Delwin E. Benson, especially the web of life game depicted on page 3.

An ongoing demonstration of the life support system can be provided through a student-constructed and maintained terrarium. The procedure is explained in "Build an Ecosystem," *Project Learning Tree**.

The web of life is never static, and virtually all species change as environmental conditions change. If we think of the time life has existed as a day, very few forms of life now on Earth will have been around for more than 7 minutes. Using the dinosaur as a springboard, students can develop this fact of life, giving their own reasons for the passing of some forms and the survival through evolution of others.

3. **Wildlife habitat needs are not unlike those of human beings. The five indispensable components are water, food, shelter, space, and the arrangement of these four.**

The habitat of each species of wildlife might be considered both individually and in its interrelatior ships with others. "Wildlife Habitat" in *Project Learning Tree** introduces this idea. It is amplified in the outdoor classroom activities from *We Can Help!** — Guide No. 1, "Plants and Places;" No. 12, "Wildlife/Wildlands Photography;" No. 18, "Wetlands and Wildlife;" and No. 22, "Farming and Wildlife."

Other resources: *Sun Earth* (See 1 Air 2 above.), Chapter 7, "Historic Use of Natural Energy."

Concept 2

Grades 7-9

THE EFFECTS OF ECOSYSTEMS ON HUMAN BEINGS

Understanding Human Dependence on Nature

1. Such features of our natural environment as climate govern much of our lives, and cannot be modified by any human efforts.

Students may explore this by listing the principal unalterable characteristics of the ecosystem in which they live. Probable features named will be climate, precipitation, topography, air pressure, basic composition of the soil. Students then discuss how our lives would be different in a sharply constrasting climate, water supply, etc. Under each heading they might list the new things or features of life and the ones that would disappear or be scarcer. These lists will be helpful if you plan to teach the next Model topic.

2. The more advanced a society becomes technologically, the more its people can adapt to unfavorable conditions in their environment.

One approach is to pose the following for debate: "We have more choices than primitive people in how we adapt to the ecosystem." Students might consider how much of their dependence on nature applies to primitive people and what adaptations primitive people make that we do not. Does the fact that we have more time left over, after satisfying the basic needs of food, water, shelter make our adjustment to the ecosystem simpler or more complex?

3. It is much simpler for people to accept whatever nature provides and live with it than to overcome natural obstacles and limitations.

One way to study this point is to contrast the life of a people who subsist entirely from the bounties of nature — hunters and gatherers such as Pygmies — with the people of an inhospitable desert or high mountain community who must overcome environmental obstacles.

Another approach is to show pictures of the dangers people choose deliberately to live with because ease is preferable to risk. In some places, disaster has struck; in others, it only threatens — Pompeii, the Big Thompson canyon, the flood plains of many rivers, San Francisco's earthquake. Make your own list. Why do people build in such places? Why did they abandon some sites and rebuild others?

WATER

1. The world's fresh water resources,

although a tiny fraction of the total, dictate where most human beings live because every one of us is completely dependent upon water.

"The Wonder of Water," a comic book in the *Better Environment* booklet series of the Soil Conservation Society of America*, is a good introduction to human dependence on water. It comes folded inside a teacher's guide containing suggested activities and discussion questions. It covers more about water than this single point. *Water,* a Time-Life book, will be useful if your library has it; many do, but it is out of print.

The importance of fresh water in deciding where people settled can be demonstrated by having students locate major bodies of fresh water on a world map. What is their relation to population?

A classroom experiment showing the difference between hard water and soft, could also be undertaken.

2. Water in the ground is as important as water on the surface and in the atmosphere. There is also a lot more of it.

Nearly all the fresh water not locked up in the polar icecaps and glaciers is in the rocks below ground, half of it more than half a mile down. The actual water distribution in the world is:

Water content of the oceans	97.2%
Inland seas and salt lakes	.008
Polar icecaps and glaciers	2.15
Rocks below the soil	.62
Average of surface lakes, rivers, soil moisture, vapor in air	.022
	100.00%

A classroom demonstration of infiltration and percolation can be carried out with glass tubes about the size of a kerosene lamp chimney. Fill each about half full of soils of different types, and pour equal amounts of water into them. Measure the amount absorbed by the different soils and the rate of percolation through them.

One of the National Audubon Society* *Nature Bulletins* is an article by the late Jay N. "Ding" Darling on "The Ground Water Table." One of its four pages is devoted to a "Ding" cartoon. Reprints are available from the Society.

3. The hydrologic cycle governs the supply we use.

The local Soil Conservation Service* has a graphic chart of the hydrologic cycle in a leaflet that includes a brief but clear description. It is called "Conservation and the Water Cycle," Agricultural Information Bulletin No. 326. An unusual chart, Figure 6 on page 7 of "Helping Wildlife,"* shows water flow under ground. Further data will be learned if one or two students interview a local well digger and find out how much deeper he digs now than five years ago.

AIR

1. We need air to breathe and it is equally important to plants and animals. Plant transpiration is necessary for human survival.

A quick demonstration of life's dependence on air is to exhaust the air from a sealed jar in which you have placed a small potted plant. The plant suffocates just as would an animal or a person. Have the class also observe the plants and animals in a terrarium with a covered top. How do they get their air? If students do not have a textbook that covers the oxygen-carbon dioxide cycle, explain that animals use the oxygen in the air they breathe and exhale carbon dioxide, while plants use the carbon dioxide and give off oxygen in the process of transpiration.

2. Air is also essential in much of our industry and in many forms of recreation.

Students might list all the ways in which air helps get people's work done — the vacuum cleaner, sandblasting to clean buildings, air drills, tires, and so on. Then list the recreational uses of air — balls, sailboats, flying kites and planes, etc. What are the properties of air that we make use of in these varied activities?

Use also the book *Sun Earth** (See 2 Water 2 above.) for its chapter "Wind/Air."

3. Air is a key factor in the climate in which we live — its temperature, its pressures, its movements.

Any class that can arrange a field trip to the National Center for Atmospheric Research* (NCAR) in Boulder should do so. See brief description in 3 Air 2 for Grades 4-6 in this Model or write to NCAR for a leaflet on the trips; reservations may be made (at least two weeks in advance) for a Tuesday, Wednesday, or Thursday during the school year. The tour will cover more than the air as a factor in climate, but all of it will be revelant to conservation education.

Another resource is the NCAR* film "Ice in the Atmosphere," 19 minutes in color. Among other things, it demonstrates the role of ice crystals in the atmosphere.

SOIL

1. The more highly industrialized and populous a society, the more products of the soil it needs — food, fibers, wood, and minerals.

Students often get the point by naming as many as they can of the products of the soil that figure in our everyday living but were unknown to primitive peoples. (Allow only a few minutes for this.) Foods, fibers, woods, inorganic materials will be included, such as aluminum and steel, hybrid plants grown for high yields, manufactured wood products, synthetics. Whether all this makes us more or less dependent upon the soil than an Indian in the remote Amazon jungles is a question that can excite discussion. Alternatively, use the Soil Conservation Society of America* comic booklet "Sharing the Earth," one of the *Better Environment* series.

2. Key consideration for supplying food, fibers, and habitat are the soil's depth, texture, porosity, salinity or alkalinity, organic content, and nitrogen.

See the activities covering these characteristics of soil in the Soil Conservation Service*, *Teaching Soil and Water Conservation.* The idea can be reintroduced with the activity in the same resource, "Compare Soils by Growing Plants in Them." These key considerations lend themselves to applying "Outdoor Classrooms on School Sites" (also Soil Conservation Service*).

3. The natural dangers to which soil is subject — erosion, depletion of nutrients, excess salts, insufficient moisture — oblige us to take protective or rehabilitative measures.

From the Soil Conservation Service* pamphlet "Soil Erosion," a class can carry out the task (working in teams on the various problems) of exploring steps to preserve or reclaim the various endangered fields depicted.

See also the Soil Conservation Society of America*, "Working Together for a Livable Land" and "The Story of Land."

ENERGY

1. The adoption of a new or different energy source often changed the whole history of civilization, and can do so again.

"An Energy History of the United States, Grades 8-9" covers the ground in fair detail and very interestingly in its 115 pages, of which 68 are for the teacher and the rest a student guide and work materials. It goes from "America's Wooden Age" through "The Coming of Coal" to "Oil: Bright Promise." It is a draft volume in the free series prepared for the Department of Energy* by the National Science Teachers Association and was issued in January 1978.

Students might refer back to the comic book "Mickey Mouse and Goofy Explore Energy" (See introductory paragraph preceeding 1 Energy 1 above.) for the changes proposed there. Each student might then draw two or three frames or write a short essay to show what other alterations in our life styles would be necessary in a serious energy crunch. The art work might be mounted on large sheets of butcher paper for a class mural.

Other resources are in the EME notebook*, Impacts — Activity 9, "Then and Now;" Uses — Activity 4, "Energy Consumption;" Impacts — Activity 5, "Lifestyle Choices and Energy Use;" and Limits — Activity 5, "The Energy Dilemma."

2. The future of human society depends in the long run upon the next great energy source.

Referring back to the EME notebook*, Sources — Activity 6, "Which Fuel?" and to the "Energy History of the United States," students might prepare reports on which source of energy is likely to make the next "energy age." Perhaps they could be asked to choose a favorite among the prospects so that teams composed of those who chose solar, geothermal, nuclear, wind, tides or whatever could work together.

See also in the EME notebook*, Limits — Activity 7, "People and Energy;" Future — Activity 1, "Solar Radiation;" and Future — Activity 7, "Nuclear Reactions — a New Language."

LIFE

1. The ecosystem's forest, wilderness,

and wildlife are important aesthetic and recreational assets.

Two suggestions from *We Can Help!** are Guide No. 11, "Public Use of Public Land" and No. 20, "Public Survey." Between them, they acquaint students with many of the recreational values of forests and wildlife.

The aesthetic and recreational assets were among the reasons Enos Mills and others pushed for the establishment of Rocky Mountain National Park*. School tours at the Enos A. Mills Homestead Cabin*, near Estes Park, can be arranged.

Also helpful are the Colorado Division of Wildlife* bilingual booklet *Game Animals of Colorado* as well as *The Fishes of Colorado* and from the Colorado Extension Service* "Exploring Wildlife" and "Fishing."

2. **Renewable natural resources largely determine the life styles and cultures of primitive peoples.**

Students can study this to good purpose by either drawing a series of pictures or writing an essay to show how their resources dictated the development of two contrasting primitive peoples — Eskimos and Pygmies, plains Indians and forest Indians, nomads in the Sahara, and Mayans in Central American jungles, or any others students choose.

3. **Today as in the past, these resources are the basis of industries and therefore, jobs.**

As an introduction, see "Biography of a Favorite Thing" in *Project Learning Tree**. Students might also research the size of the employment and value of gross national product in the principal industries that are supported by forest, wilderness, and wildlife — hunting and trapping commercially, lumbering, commercial fishing, tourism.

The EME notebook*, Limits — Activity 3, "Conserving Natural Resources," may be useful.

4. **The principal food crops that a given region grows best because of its special ecosystem strongly affect local life styles — as a rice culture in contrast to a grain culture.**

This has been taught successfully by having students research the cultural differences attributable to diet — the rice culture of the East vs. the grain culture of the West, meat eaters vs. fish eaters, vegetarians vs. omnivores. Other topics might be the influences of national foods — pasta for Italy, arroz for Spain, potatoes for Ireland, and so on.

Concept 3

Grades 7-9

HUMAN BEINGS ARE NOW THE MOST INFLUENTIAL OF EARTH'S ORGANISMS

Understanding Human Impacts on the Environment

1. People exercise their greatest influence upon ecosystems through their technology.

The title activity, No. 1, in "Energy, Engines, and the Industrial Revolution" (Department of Energy*) will give students a good grasp of this concept. In the EME notebook*, Limits — Activity 3, "Conserving Natural Resources" also will be useful.

2. The increase in human populations, especially in the last century, has altered much of Earth's face.

A chart of the world's population growth up to the present, is one introduction. Note the length of time for the first doubling, and for subsequent doublings. Then to bring the impact of that growth to manageable proportions, you might invite the class to map or describe changes in the local environment caused by increased population. Contrast this with areas that have experienced little or no population growth. Help students keep a balance by avoiding concentration on either the destructive or the pleasanter aspects of the impact of people. Population growth chart and other data are available from the Population Reference Bureau, 1337 Connecticut Ave. N.W., Washington, D.C. 20036.

3. The condition of wildlife illustrates in very special ways the attitude and behavior of people where conserving the environment is concerned.

See *Project Learning Tree**, "Pioneers in the Wilderness" and "Hard Choices." This might be followed by a student debate, in the form of individual essays or by teams. A possible division is over the issue of exploiting natural resources for human benefit and using them in the best interests of the future and other forms of life. The object is to note how different attitudes affect the environment.

Yellow Ore, Yellow Hair, Yellow Pine, A Photographic Study of a Century of Forest Ecology returns us to the 1874 Black Hills Expedition commanded by General George Armstrong Custer. Photos and narrative compare what happened in 100 years and how human actions apparently affected wildlife, natural resources, and the environment. It is available from the Division of Wildlife*. See also the part on what wildlife managers do, pp. 21-24 in "Helping Wildlife,"*, by Delwin E. Bensen, and "Hard Choices" in *Project Learning Tree**.

WATER

1. **Uses that pollute water supplies — industrial, agricultural, and urban wastes mainly — are one of technology's main impacts. Yet technology also has helped to restore and preserve water quality.**

Guide No. 10, "Water Quality Analysis," in the *We Can Help!** series is a good introduction. "The Stream Bottom as an Indicator of Pollution" from *Outdoor Facts*, Fishery Information No. 11, can be obtained from the Division of Wildlife*.

The constructive side is shown in a film, "Brown Trout, Yellow Bulldozers, and Black Asphalt," a documentary on the cooperation of several agencies in rerouting Ten Mile Creek in the rebuilding of the last portion of Route I-70 near Frisco, Colorado. This engineering and ecological feat not only saved a stream slowly recovering from pollution but vastly improved it as habitat for fish and plants. It is on loan from the Division of Wildlife*.

2. **Irrigation in the U.S. has become the greatest user — and re-user — of water in the country.**

The Soil Conservation Society of America* comic book, "The Wonder of Water," sets irrigation in perspective.

3. **Modern dams, tunnels, drills, and pumps enable us to redistribute water in far greater volume and over greater distances than was ever possible previously.**

The Soil Conservation Society of America* booklet, "The Wonder of Water," describes the vast water works of recent times. Students then can check the map "River Basin and Watershed Progress — Colorado" (Soil Conservation Service*) for the number of projects completed, authorized, and applied for. How much of the state's water still flows in the natural channels?

4. **The impact of people on water resources is demonstrated by learning where the local water supply comes from and where it goes.**

Student research into the history of the local water supply is one way to develop this theme. You might invite an official from the local water system to address the class, or visit the water works after arranging for one of the staff to be present to explain the system and answer student questions.

AIR

1. **The quality of air, at least near Earth's surface, is impaired in varying degrees as the result of technology. Industry, transportation, and waste disposal are the chief despoilers.**

Have the class collect newspaper and other data on air pollution in the nearest city or industrial complex. The EME notebook*, Impacts — Activity 8, "What's in the Air? Who Put it There?" may be helpful.

2. **The undesirable impact of technology upon air quality inspires human attempts to reverse the process. The recent history of any big city or industrial complex illustrates this.**

Students might continue their study of what the nearest city is doing. The "Air" chapter, pp. 33-53 in *Save the Earth**, by Betty Miles offers both background and suggestions. See especially the section, "Taking Action — The Story of Pittsburgh and the Long Clean-Up." Equally valuable but different is *Project Learning Tree**, "A Letter from Archy."

SOIL

1. **The impact of technology has been destructive when applied so as to increase erosion or deplete nutrients, but remedial or productive when applied according to the soil's particular needs.**

For both points, see the Soil Conservation Society of America* booklet, "The Story of the Land, Its Uses and Misuses Through the Centuries and Today." For positive effects or impacts, use another booklet in the same series, "The Idea That Worked." In the EME notebook*, see Sources — Activity 2, "Energy Used in Producing Food;" Uses — Activity 2, "Population vs. Food: An Energy Problem;" and Uses — Activity 7, "Eating Energy."

2. **Grasses, by far the greatest source of human food, exemplify our interaction with nature's systems.**

A useful class study is "Grass," a Soil Conservation Service* leaflet (Agriculture Information Bulletin No. 221). Then students might map the areas of Colorado where grasses introduced by farmers — corn, wheat, etc. — have replaced the native varieties.

3. **Local land use patterns, whether or not farms are displaced, illustrate human impacts on the soil.**

Students need do no more than map the neighborhood of the school as it is now and as it was before the original settlement. See EME notebook*, Impacts — Activity 10, "A Land Use Attitude Survey."

ENERGY

1. **Our influence on the environment comes chiefly from the ways we use energy and the amount we consume.**

The EME notebook*, Impacts — Activity 8, "What's in the Air? Who Put It There?" deals with this point. See *Project Learning Tree**, "A Treasure Hunt for Energy," and in the EME notebook*, Sources — Activity 5, "Energy Use in Providing Shelter;" Sources — Activity 7, "Energy Used in Providing Clothing;" and Future — Activity 4, "Dispose or Recycle."

2. **People's decisions on energy uses in one generation affect the energy resources available to future generations.**

The EME notebook* offers two activities that guide students toward discovering this fact — Limits Activities 1 and 2, "Depleting Energy Sources," and "A Trip to 'New Earth.' "

3. **The different life styles people choose call for different amounts of energy, and so have different impacts on the environment.**

A statistic that puts this succinctly is that the U.S. with 6% of the world population uses 50% or more of the world's energy produced from fuels. The EME notebook* deals with the greater impact on the environment of industrialized societies as compared with agrarian societies, especially through energy uses, in Impacts — Activity 9, "Then and Now." Other useful activities from the same source are Impacts — Activity 2, "Selection of a Power Plant Site;" Future — Activity 3, "Nuclear Plant Location;" and Impacts — Activity 7, "Traditional Values and Energy-Use Problem Solving."

LIFE

1. Human diversion and use of natural resources can benefit or harm wildlife.

The film "Brown Trout, Yellow Bulldozers, and Black Asphalt" (Division of Wildlife*) presents an outstanding example of one impact people have on wildlife, the rechanneling of Ten Mile Creek to improve the quality of the water, provide better habitat for animals, and preserve some splendid scenery. A field trip to one of the State or National Parks* will reveal other aspects of our effect on ecosystems. Write ahead for information leaflets to prepare the class, and to arrange for a guide who will be able to explain conditions in the park and answer questions. For some of the less pleasant results of people's activities, a field trip to almost any abandoned mine or a study of the history of the site of the local community will be sufficient.

Alternatives are the Soil Conservation Society of America* booklet in the *Better Environment* series, "Making a Home for Wildlife on the Land," or *Project Learning Tree**, "Lovin' It to Death."

2. People have drastically changed both the animal and plant species of vast sections of the country — Colorado included. We raise corn, wheat, and alfalfa in place of native grasses; graze cattle and sheep where bison, elk and deer once thrived.

An approach would be a class discussion of what has replaced the bison and much of the grassland they roamed. What replaced the other "endangered species" that are listed? Alternatives are Guide 24, "Endangered Species: Mystery Birds" from the *We Can Help!** packet, which explains the ecological impacts that threaten these animals. Also helpful are *Project Learning Tree**, "Endangered Species," and the section in "Helping Wildlife,"* p. 22, concerning how to assist threatened and endangered species.

A field trip to the Plains Conservation Center* just east of Denver will give students an excellent learning experience of the land that has not been changed. They can compare it to virtually any part of the Colorado Plains they know or have seen.

3. Wildlife management is especially important for both game and non-game species in Colorado.

Background information about wildlife management in this state may be obtained from the Division of Wildlife*. Ask especially for *Outdoor Facts*, a publication of the Division that gives information in short leaflets about many species, and the bilingual *Game Animals of Colorado*. Also helpful is *Today's Strategy ... Tomorrow's Wildlife* as a comprehensive Colorado wildlife management plan available for $3 from the Division of Wildlife. "Exploring Wildlife" is also useful, obtainable from the Cooperative Extension Service*, Colorado State University, Fort Collins, CO 80537.

With this material in hand, and from library resources available to them, students can research questions of wildlife management, including preserves or sanctuaries, hunting and fishing regulations, and the population dynamics of animals in an untouched wilderness and in a managed area. See also the section in "Helping Wildlife"* on pp. 17-19, relating to several aspects of wildlife population management.

Concept 4

Grades 7-9

OUR ABILITY TO COMPREHEND MUST BE COUPLED WITH THE OBLIGATION OF SELF-CONTROL

Understanding Human Responsibilities and Opportunities

1. **We all recognize the importance of conserving natural resources (using them wisely) but differ over what should be conserved and how.**

*Project Learning Tree**, "Native Americans and the Forest" and "Pioneers in the Wilderness" are two of several PLT lessons that speak of this. *Project Learning Tree** "The Continuing Adventures of the Truffle Tree Company," which makes use of the Dr. Seuss film or story, "The Lorax." On the basis of either of these, the class might discuss what to conserve and how. The discussion can lead to the following topic, if desired.

2. **However our attitudes impel us to answer *what* and *how*, we will be involved in:**

   A. **Assigning priorities among competing users;**

   B. **Arranging trade-offs, often economic, after deciding which of our needs or desires to satisfy;**

   C. **Encouraging or helping the search for alternatives to items in short supply.**

*Project Learning Tree** offers two activities bearing on the problems posed. "The Three Little Pigs Revisited" deals with the priorities, trade-offs, and alternatives as the class determines what kind of a house to buy or rent. "Local Recreation Preferences" puts the question in terms of use of leisure. As students take up either project, keep before them the three chief issues involved — their own choice of priorities, the trade-offs necessary to reach those priorities, and what alternatives they desire.

3. **In Colorado, one way of seeing these problems clearly is through studying their effects on wildlife.**

*Project Learning Tree** includes two activities for this. In "Wildlife Habitat," students face the problem of managing a forest for timber in the face of an increasing deer population. Alternatively, "Endangered Species" allows students to see the problem from the standpoint of animals threatened with extinction.

A film, "So Little Time," 28 minutes on the need to conserve a wildlife species threatened with extinction (Division of Wildlife*) explains the principles. Or use "We Can Save the Eagle," an eight-page National Wildlife Federation* leaflet, gives tips on what to do as well as the background of the problem.

4. **Organized conservation is relatively new in the U.S. Its history since the late 19th Century helps explain today's issues.**

The Soil Conservation Society of America* *Better Environment* booklet, "Pioneers of Conservation in America," covers this history from the generation of the founding fathers

through Lincoln's establishment of land grant colleges and the Department of Agriculture to such innovators as Muir, Pinchot, and the rest, and on to the present. The Teacher's Guide suggests ways to involve students in community conservation.

Another approach is to assign each student to research a one-page sketch of the achievements of one great name in conservation — men mentioned in the "Pioneers" booklet, some of the state's conservationists and those of your own locality.

WATER

1. Wise management of fresh water resources involves:

A. Preventing and reversing pollution;

B. Allocating supplies to essential and best economic uses;

C. Eliminating waste and promoting re-use.

One way to cover the whole topic is to show the film, "It's Only Water," on loan free from the Denver Water Department*. The point made most emphatically is that we can no longer afford, if ever we could, to take water for granted. The *Captain Hydro** series would be valuable here. All three points also are covered in the Soil Conservation Society of America* *Better Environment* booklet, "The Wonder of Water."

Another approach to the pollution problem would be to have students look up in *Reader's Guide to Periodical Literature, 1976-77,* the "grey waters" of Marin County, California, and what happened to a community that rationed each citizen to 45 gallons a day.

2. The attitude needed for such management prinicples can be illustrated by applying them to:

A. Local conditions in home, school, and community;

B. Nearby aquatic wildlife.

A class project to see how much water students can save in a week is a proven teaching method. Washing a car from a bucket instead of with a hose, turning off water that habitually is left running needlessly, and any re-use would be typical examples. Each student calculates the liters (gallons) saved, and adds them up for the whole class. (A simple re-use of water is to take what is left from cooking, pour it into a container to cool instead of down the drain, and sprinkle it on a garden or house plants.)

Use of "A Lesson Plan Outline for Measuring Some Water Quality Criteria" is taught in U.S. Forest Service* Environmental Education Workshops. Additional resources include *Project Learning Tree**, "Water We Doing?" and "How Clean Is Clean?"

For a start on the aquatic wildlife topic, the film "Still Waters" from the Division of Wildlife* might be shown and other ideas are in the *We Can Help!** packet, Guide 19, "Fish Populations." A field trip to a nearby marsh or swamp enables students to observe the many forms of life that depend upon its water. A class discussion of what would happen if the marsh were drained might follow. How many species could survive on dry land? If the class visits one of the State or National Parks* that has an aquatic life feature, be sure to ask the guide to include it in the tour.

AIR

1. Our obligation is to maintain air quality in as good condition as we find it. The first step is to determine what this goal requires of us, economically as well as socially.

In the EME notebook*, Impacts — Activity 2, "Selection of a Power Plant Site," or Impacts — Activity 3, "Future Nuclear Plant Sites," deal with this. Also review Impacts — Activity 8, "What's in the Air? Who Put It There?"

2. Some communities control air pollution

better than others.

This is often discovered through independent team projects, three or four students to a team. They study the clean air efforts of major U.S. cities, and a few even if not so major in Colorado. One of them could be your own, but Denver should be on all the lists. New York, Los Angeles, Pittsburgh and St. Louis are good examples.

3. Every individual can participate in a clean air campaign.

A class project may show what individuals can do. The local board of health, any local air pollution control agency, or a private conservation group are resources for materials on air pollution and on what the class could do locally to help. It may be no more than preparing a leaflet for distribution in the community or an editorial in the school paper.

SOIL

1. Major soil conservation measures are:

A. Reducing erosion;

B. Maintaining or restoring plant nutrients in the soil;

C. Maintaining or improving soil moisture content.

All three phases of soil conservation are dealt with in the Soil Conservation Society of America* *Better Environment* booklet, "Food and the Land." In the same series, "The Story of the Land" deals in more detail with erosion.

"A Lesson Plan for Soil Investigation in Land Use Planning" as taught in the U.S. Forest Service* Environment Education Workshop will prove helpful here. The soil conservation measures can be taught using the suggestions made in the Soil Conservation Service*, "Outdoor Classrooms on School Sites."

2. Individuals and the groups to which they belong have a role in soil conservation even if not farmers, ranchers, or foresters.

What should be done, what has been done in schools, and what can be done by individuals is well handled in *Teaching Science with Garbage,* by Albert and Vivian Schatz. Subtitled "An interdisciplinary approach to environmental education from the points of view of science, mathematics and social studies," its first 10 (of 30) short chapters deal with down-to-earth soil conservation suggestions, such as "What One School Did With Garbage," "What You Can Do in Your School," "Biodegradability," and "Compost Your Own Garbage." Write for price to Rodale Press, Inc., Emmaus, PA 18049.

Another approach is taught in the U.S. Forest Service* Environmental Education Workshop using "A Lesson Plan for Investigating the Range Environment."

ENERGY

1. The need to conserve energy for any other reason than to save money is a fairly new idea in this country. Many organizations, public and private, now engage in energy conservation programs on ecological as well as economic grounds.

The point has been made successfully by having the class identify the various agencies or organizations, private as well as public, that are concerned in your community with the consumption and conservation of energy. Students collect information from each on the economic and ecological factors, and learn how much of a problem conserving energy poses in the community. EME Sources —

Activity 6, "Which Fuel?" and Sources — Activity 4, "How Does It Happen in Your Town?" can be used.

2. Specific energy conservation issues and opportunities are:

A. Recycling things that take a lot of energy to produce;

B. Turning the switch to "off;"

C Converting to appliances and activities that need only a little energy from those that use a great deal;

D. Dealing with transportation, the most debated energy conservation issue in the U.S.

The EME notebook* Future — Activity 5, "Power Consumption at Home," is a good start to a class project that will enlist each student as a conserver of energy at home and at school. Each can use the data in the EME notebook to calculate savings of energy by turning off the switch, recycling things that need a great deal of energy to make, choosing alternative activities to those that use energy from nonrenewable sources — walking instead of riding, for example. After a fair test of their efforts, have the class estimate the amount of coal, oil, and gas that has been saved.

Teaching Science with Garbage (See 4 Soil 2 above.) has several pertinent chapters — 13, "What Happens to Metals;" 15, "How About Incineration?;" 16, "Recycling Solid Wastes;" 17, "Recycle Fats;" and 22, "How Much Glass Do You Use?"

Vol. 4, "Transportation and the City," in the series produced by the National Science Teachers Association for the Department of Energy* is a 46-page booklet evenly divided between teacher's guide and student resources in four parts. All involve active student participation.

An extension of the recycling aspect is *The Game,* a simulation on litter developed for Keep Colorado Beautiful*.

LIFE

1. Conservation of resources deserves to be a major goal of all land management, from a city or suburban yard to all the public lands. Farms, range, wilderness, urban developments, highways are included.

Various *Project Learning Tree** activities deal with these questions. See "We Can Work It Out," "How Much Is Enough?," "Design With Nature," "Plan Your Community's Future," "You've Come a Long Way, Maybe."

On wildlife aspects, the film "Dapples & Grays — Pintos & Bays," 20 minutes, deals with land management and a herd of wild horses, or a slide show, "Wildlife in Colorado," ranges from grass to timber. Both are available on free loan from the Division of Wildlife*. Other resources: Two booklets produced by the Wildlife Management Institute* — "Placing American Wildlife Management in Perspective" and "The Hunter and Conservation" — and the Soil Conservation Service* pamphlet, "More Wildlife Through Soil and Water Conservation."

Training in how "A Plan for Land Use Simulation" addresses urban development as part of the U.S. Forest Service* Environmental Education Workshop.

2. The quality of life depends upon the degree to which we carry out our obligations and seize opportunities to conserve natural resources.

*Project Learning Tree**, "Hard Choices" and "Would You Like That Wrapped?" contain useful activities. For an exercise in home conservation, see "Paper Consumption." Alternatives are "A Lesson Plan for In-

vestigating a Forest Environment" (U.S. Forest Service*) and Chapter V, "Investigating Wildlife" in *Environmental Respect* A New Approach to Outdoor Education prepared by Albert R. Huck and Eugene Decker. *Environmental Respect* contains concepts, a selected glossary and teaching topic outlines. Single copies are $3.00 from the Safari Club International Conservation Fund, 877 S. Alvernon Way, Tucson, AZ 85711.

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RESOURCES

Grades 10-12

Teaching suggestions for this grade level include greater reliance on specialists from the community at large than was the case earlier in the Model. Some can be invited to speak at the school. Others will explain their specialties on their own grounds — a water works, fish hatchery, power plant, park, waste disposal operation, wildlife preserve, or whatever. You may know of experts not mentioned here.

The named sources to help prepare student volunteers for service with conservation agencies do not exhaust the possibilities. You probably can add to them without leaving the community.

All resources are keyed to the corresponding items in the "Strengths and Needs" Instrument by number and symbol. Alternatives usually are given, sometimes for use in courses on different subjects, sometimes of more or less difficulty and length. No new course is proposed; the resources fit into the existing curriculum and should strengthen course content.

Most of the activities and strategies outlined in these pages have been used successfully in teaching the topics listed in the "Strengths and Needs." Teachers' modifications to meet the specific needs, interests, and experience of their classes are encouraged.

Throughout the "Resources," an asterisk (*) marks the names of all sources for more than a single recommended teaching aid or strategy. For example, the Soil Conservation Service is a prolific resource. The asterisk beside its name means that the address and other necessary details for obtaining its materials are carried in Appendix A.

For those who wish more information, a list of agencies and institutions that offer extensive printed matter and audio-visual aids in their own conservation specialties will be found in Appendix B.

Concept 1

Grades 10-12

THE WHOLENESS OF EARTH'S SYSTEMS

Understanding the Biosphere

1. The biosphere is stable, operating through a highly complex but orderly, interacting, interdependent system of natural forces and resources.

The earth sciences textbooks used frequently cover this topic. To dramatize the wholeness concept, students might explore, individually or in teams, the forces that create quite different environments. It has been found helpful to show pictures or slides of some contrasting regions: *wet and warm,* the Southwest Monsoon that gives the east coast of India one of the highest annual rainfall totals on Earth; *dry and cool,* the Humboldt or Benguela Currents and prevailing winds that create deserts on the west coasts of Africa and South America; *rich and temperate,* the conditions that create the Midwest breadbasket of the U.S.; *cold and high,* the Alpine sections of our own Rocky Mountains.

2. Ecosystems are also fragile, subject to great and even violent change through an alteration in one or more natural forces.

Students might prepare reports on what would result, or what has resulted from a change in the natural forces that created the special environments noted in #1. The balance can be upset by alteration in winds, currents, temperature or air pressure changes, etc.

3. The stable and fragile features of students' own environment will disclose how the ecosystem operates.

On the basis of their study of the four environments, students might list the stable and fragile features of the local ecosystem. Their knowledge of local history should help. See also the EME notebook* Limits — Activity 4, "Limit?," and *Project Learning Tree**, "Why Do Trees Grow Here?"

*The Range Science Review** *Audio Cassette Tape Program,* Vol. 2, No. 1, "Ecological Principles and Ecosystem Concepts" is suitable for individual listening by above average and highly motivated students interested in ecological niches, population dynamics, and successional ecology. The audio cassette tapes are available for purchase at $5.00 per tape from the Colorado State University, Range Science Dept., Ft. Collins, CO 80523 or for loan from the Colorado Division of Wildlife Library*.

WATER

1. A major factor contributing to the

wholeness of the Earth's systems is the interdependence of sea and land.

A reading on the role of the oceans in the overall regulation of the biosphere and the special influence of currents such as the Gulf Stream might be followed by a writing assignment in which students would describe the relationship between Colorado and the sea. For a basic reading, suggest Rachel Carson's *The Sea Around Us* or *Peter Freuchen's Book of the Seven Seas.*

2. The hydrologic cycle furnishes a surplus or deficit of fresh water to every locality. These can be calculated precisely.

In calculating a "water budget," specialists figure precipitation as income; water in the ground and evapotranspiration as outgo. The difference is either a surplus or deficit, giving the expert data on how much could be used elsewhere or how much more is needed on the spot to maintain soil moisture. Here are three representative Colorado locations with their water budgets stated in millimeters:

	Income	Outgo[1]	Surplus/ Deficit
A mountain station at 10,000 ft. (3,048 m.)	817	392	+425
A near desert at 7,000 ft. (2,134 m.) . . .	154	518	-364
A dry-farming plain at 5,000 ft. (1,524 m.) .	366	621	-255

[1]This is either the actual evapotranspiration or what could be the case if the water supply were sufficient.

Students can obtain the figures for their own area from the nearest weather station, and calculate the surplus or deficit in preparation for examining local water needs and resources. Data may also be obtained by writing to: State Climatologist, Colorado State University, Fort Collins, CO 80521.

The importance of water in the functioning and structure of the ecosystem, the hydrological cycle and the influence of land and management practices on the hydrological cycle are learnedly discussed in *Range Science Review**, Vol. 3, No. 4, "Hydrological Cycle in the Range Ecosystem." Also listen to Vol. 1, No. 9, "Drought — An Important Factor in the Range Ecosystem."

AIR

1. The envelope of air enclosing the world has many functions. It regulates such biospheric routines as the amount of sunlight admitted to the Earth and the transportation of water vapor from areas of evaporation to areas of precipitation.

The role of the air is described adequately in most texts. A way of teaching the subject in a more exploratory manner is suggested in "Weather and Climate," pp. 125-131 of *Ten-Minute Field Trips** by Helen Ross Russell. Most of the activity is in the classroom.

2. How atmospheric conditions operate to create weather is illustrated by the special influence of Arctic air on Colorado.

A brief reading and teaching strategies are provided in *Geography of Colorado** by Joy Clapp and Paul C. Stevens. See the chapter "Climate of Colorado," p. 19. Available from Old West Text Books, P.O. Box 990, Boulder, CO 80302.

If possible, arrange for a class tour of the

National Center for Atmospheric Research* (NCAR) in Boulder. Schools can arrange these for Tuesday, Wednesday, or Thursday throughout the school year by making the appointment at least two weeks in advance. A guide suitable to the class's age is provided. The tour will cover virtually all aspects of the atmosphere covered in this Model. In making the appointment, ask NCAR for leaflets suitable in preparing students for the visit.

SOIL

1. Soil naturally builds and renews itself through the weathering of rocks and decomposition of plants and animals.

Use Activities I and V, "Make Some Soil Artificially" and "How Does Organic Matter Help Soil Structure?" in *Teaching Soil and Water Conservation* (Soil Conservation Service*). Earth science textbooks also should prove helpful. *Range Science Review**, Vol. 2, No. 3., "Energy Flow and Mineral Cycling in Rangeland Soils" trace the role of microorganisms in mineral cycling. Also listen to Vol. 1, No. 3., "Energy Flow and Management of the Range Ecosystem."

2. Soils naturally are depleted or changed by a process of succession; they can be shifted and their composition altered by erosion.

Various textbooks and library references probably describe the process of soil formation and renewal, erosion by wind and water, and the soil succession patterns. For other teaching strategies on biology and conservation and chemistry and conservation, see 'An Outline for Teaching Conservation in High Schools," Soil Conservation Service* booklet PA 201.

3. The quality of natural soil — especially the depth, texture, porosity, salinity, and nutrient content — is of vital importance to every locality.

See the U.S. Forest Serivice* Workshop, "A Lesson Plan for Soil Investigation in Land Use Planning." The fundamental point is made briefly in "Helping Wildlife" in the soil section describing foundations for life on page 6. See also *Project Learning Tree**, "Growin' Seeds and Savin' Soil." The soil-plant atmosphere as a continuum with the effects of water stress on plant growth and development are examined in *Range Science Review**, Vol. 3, No. 10, "Soil — Water — Plant Relationship."

ENERGY

1. The nature of energy and its conversion from one form to another may need to be reviewed, including the first and second laws of thermodynamics.

Methods of demonstrating the first and second laws of thermodynamics in sound conservation terms are offered in the EME notebook*, Conversions — Activity 1, "Trends of Nature." A shorter activity, if students already know the first two laws of thermodynamics is in Conversion — Activity 4, "Heat Conversion and Transfer."

2. The sources of energy are many, some renewable and others not.

The EME notebook*, Sources — Activities 1 and 4, "A Tidal Power Unit" and "Energy Costs," bring out this point.

To go into more detail, see the first three

activities in this section, each dealing with various energy sources. Also see Limits — Activities 1 and 2, "Oil, A Finite Resource" and "Consumption."

3. The distribution of these resources is uneven, and some are more continuously apparent than others. Sun and wind are always obvious; coal and oil only when you look for them.

The EME notebook*, Limits — Activity 4, "Limit?," goes into this in a general way. For a different approach, see the flow of energy traced in "Helping Wildlife,"* pp. 1-4.

LIFE

1. Change is the biosphere's law of life. It is usually slow and gradual but may be rapid, as in the succession of life that appears on a bare vacant lot or in a forest after a fire.

The topic might be introduced by asking students if they have seen progress in vegetation and living things on a bare vacant lot or in the woods after a forest fire. Further activities could then be undertaken along lines outlined in Helen Ross Russell's *Ten-Minute Field Trips**, pp. 92-94, "Succession." See also the explanation of ecological succession, pp. 10-11 in "Helping Wildlife;"* *Project Learning Tree**, "The Changing Forest;" or the *We Can Help!** packet, Guide 8, "Old Ponds and Young Ponds."

2. The needs of all wildlife are food, water, shelter, and favorable arrangement of these in space.

A good graphic explanation of habitat is in "Helping Wildlife,"* p. 9. See also "Wildlife Habitat," in *Project Learning Tree** or "Predator Prey;" and in the EME notebook*, Conversion — Activity 2, "Mouse Study."

"Investigating Wildlife" is a teaching unit within *Environmental Respect* A New Approach to Outdoor Education*. The materials prepared by Albert R. Huck and Eugene Decker contain concepts, a selected glossary and teaching topic outlines. Single copies are $3.00 from the Safari Club* International Conservation Fund, 877 S. Alverton Way, Tucson, AZ 85711. *Range Science Review**, Vol. 1, No. 6, "Range Nutrition," examines animal nutritional requirements for various body functions.

3. Population dynamnics for plants and animals are an orderly progression in which birth, life, and death are equally indispensable.

The facts of life for population dynamics — rapid and numerous reproduction by life on which other life feeds; slow and few reproduction by predators — are explained well in the examination of population dynamics, pp. 13-16 of "Helping Wildlife."* See also *Project Learning Tree**, "Climax Forest."

4. The forces operating the biosphere can be studied through plants and animals indigenous to the locality.

See also *Project Learning Tree**, "Johnny Appleseed on Mars," where the point is made through a study of trees, or "pH and Plants," and the *We Can Help!** packet Guide 14, "Foreign Language." Primary productivity on rangelands and photosynthesis are explained in *Range Science Review**, Vol. 1, No. 4, "Canopy Architecture, Photosynthesis, and Primary Productivity on Rangelands." Vol. 1, No. 5, "Photosynthesis, Carbohydrate Reserves and Rangeland Management" may also prove helpful.

Concept 2
Grades 10-12

THE EFFECTS OF ECOSYSTEMS ON HUMAN BEINGS

Understanding Human Dependence on Nature

1. The force of the ecosystem's hold over us becomes most evident when something happens — drought, flood, famine, hard times.

Students might explore what happened to people when one of the natural forces that created the environment failed. For those who selected India, the answer is famine when the Monsoon failed; for South America, floods the year the Humboldt Current disappeared; for the Midwest, dustbowl, frosts, or floods; for the high mountains, hard times at ski resorts and dangerous lowering of reservoirs for communities below.

2. Populations tend to be concentrated in places with the most favorable habitats for human beings, a tendency we share with the whole animal kingdom.

The biggest concentrations are in cities. The class might list the five (or more) largest metropolises in the world, and analyze the environmental factors that encouraged the growth. What more was needed than the basic features of water, food, shelter, space, and arrangement that apply to wildlife? Focus thinking on natural forces and resources. For independent work, student teams might research the different cities.

3. The local community is an example. Students can examine favorable and unfavorable features of their own natural environment.

How many of the environmental factors presented in their study of great cities can students apply to the local community? What would they consider favorable and unfavorable for the place in which they live?

An Interdisciplinary Project

At this point, the many aspects of conservation education can start to come together and be reinforced by organizing students as a mock city council or state assembly to draft a model conservation code. This can be done in either the junior or senior year either with the entire class or with students in a single home room. All subjects will contribute. Supervision can be by a faculty department, an interdisciplinary faculty committee, a single teacher, or students themselves with a faculty advisor.

The "legislature" should be organized early enough in the school year to give standing committees time to do their work. A list of the committees can be posted so students can choose the one they wish to join — they should give three choices to permit even distribution. The minimum number of committees should

be Water Resources, Clean Air, Land Use, Energy, Wildlife, Waste Disposal, Recreation and Parks. Committees elect their own chairpersons and form the subcommittees they need. The Model suggests topics these committees might consider (the last numbered item under each focal point is particularly applicable), but students should not be confined to these.

Committees should complete their drafts of the model code sections six weeks before the close of a semester so that drafts may be reported at an assembly or circulated. A full floor debate should be scheduled two or three weeks before final examinations. The committee may be few and consist of only three or four members or many and large, 20 or more members, depending on whether the "legislature" comprises a home room group or the entire class.

As an alternative, a similar idea, less comprehensive but more highly structured, is contained in a simulation game, "Colorado Problems and Promises," by Charles A. Bottinelli and Carol Hildebrand. It was developed as a game based upon a study authorized by the Colorado General Assembly in 1970. The simulation was made possible through a grant from the Public Service Company of Colorado. The game lists 25 conservation bills that are to be considered by five committees of the Colorado Senate. The roles of 35 Senators are detailed with an envelope of information on each — name, constituency, committee membership, and so on. Spirit masters, a transparency, and a large map of Colorado are also provided. It is recognized that in the average class, students will play more than one role.

WATER

1. **Water historically determined the location of human habitation from the tribe beside a clear stream to cities with natural harbors.**

Students can be assigned independent research on the influence of water on the settlement of Colorado communities. This might be done in teams or individually, giving wide choice of cities, town, farming or mining communities, etc.

Where *Geography in an Urban Age** (product of the National Science Foundation supported High School Geography Project) is available, the unit on "The Growth of Cities" is applicable. Particularly relevant to this topic are the activities "Site Selection," "A Few American Cities," and "The Story of Portsville."

Alternatives are *Project Learning Tree**, "Snow Use," and from *We Can Help!** Guide 5, "Snow Temperatures."

2. **Tidal waters — estuaries, bays, salt marshes, shallows, and sand bars — moulded the civilizations of large coastal areas.**

These waters are generally recognized as among the most endangered habitats in the country. See the pamphlet "Estuary, What a Crazy Place," obtainable from the National Wildlife Federation*. How does the threat to wildlife there compare to the situation of similar aquatic species in Colorado? For descriptive booklets on the state's fish and waterfowl, write to the Division of Wildlife*.

3. **The effect of nature's fresh water supply on the development of a local community can be traced. Start by calculating the local surplus/deficit pattern.**

From the local weather station, you can obtain data needed to calculate the water budget for your area. (This is the student Water Committee task if the mock legislative body has been formed.) For most of Colorado, the

bottom line is a deficit. What has been the effect on the development of your area? This activity should be confined to the natural supply; what the people have done comes later. See *Project Learning Tree**, "Water We Doing?"

AIR

1. Air masses bring our weather, and we have to live with it. In many places, we are helpless against windstorms.

A weather textbook or chapter will provide the information on air masses and their role in the weather. For useful student material on windstorms, write to the National Center for Atmospheric Research* for their reprints "Chinooks, Thunderstorms, and Tornado Cyclones" and "Boulder's Winds." If possible, take students on a field trip to NCAR. (See 1 Air 2 above.) Or use the climate chapter, p. 19, in *Geography of Colorado** (1 Air 2 above).

2. Air temperature and movement influence various industries — fruit crops on the Western Slope, location of factories in the Denver area, and of entire communities. What is the situation in your region?

If a local industry or industries have considerable emission, an official might be invited to tell the class how wind influenced location of the plant, if it did. Students can research wind effects locally; this would be a task for the mock legislative Clean Air Committee if one is formed. As a class or group project, the student chairmen can write to the National Center for Atmospheric Research* for suggestions, giving details of the project.

SOIL

1. Soil characteristics determine the life styles and numbers of people all over the world — we speak of "the Fertile Crescent" or "America's breadbasket."

Comparison of two maps of the world, one showing the Earth's croplands, the other its population, is a good introduction. Such maps are featured in *Goode's World Atlas**; recent ones are reproduced in *Geography in an Urban Age** in the activity called "Hunger" in the "Manufacturing and Agriculture" volume. Students might discuss why the areas of most cropland and population are almost identical in Europe and Asia, but not in the rest of the world.

2. Destruction or serious damage to the soil by natural causes can compel large communities to abandon their land.

Many once populous lands that are now desolate are described in the Soil Conservation Service* pamphlet, "Conquest of Land Through 7,000 Years." Reading this, students can sort out the lands that were wasted by natural wind and water erosion from those that were abused by people and from those that still produce plentifully. If a student Land Use Committee has been formed, it might consider how the destruction might have been prevented, and what the Colorado situation is in respect to natural erosion.

3. The influence of soil types upon the community in which the school is located illustrates the point.

"Land Allocation," a role playing game from *Project Learning Tree**, would be a good preliminary to a student investigation of how the quality of soils affected development of their area. As a special assignment, this fits the student Land Use Committee. Soil Conservation Service*, "Outdoor Classrooms on School Sites" and *Teaching Soil and Water Conservation* can be extended for use here.

ENERGY

1. **The introduction of a new or previously little used energy source has repeatedly altered a people's way of life.**

A good starting place would be Impacts — Activity 4, in the EME notebook*, "Environmental Impacts of Transportation," which deals with the changes brought about by only one aspect of new energy sources. It could lead to discussion of others or independent research by the class. See also "An Energy History of the United States," developed by the National Science Teachers Association for the Department of Energy*. Although recommended for Grades 8-9, the activities on transition from wood to coal are suitable for high school.

2. **Energy distribution has significant effects upon the economy. Changes may create or destroy jobs, enlarge or diminish profits, aid or hamper technological development.**

In Conversion — Activity 7, in the EME notebook*, "Benefits of Conversion Technology," students explore the effects of introducing a new energy source to a primitive society. Limits — Activity 8, "Solutions to the Utilities Economic Problem," brings the question down to the present day.

3. **Energy distribution creates political problems, national and international.**

The interdisciplinary student/teacher materials in Energy, the Environment, and the Economy, developed by the National Science Teachers Association for the Department of Energy*, have two volumes related to the political aspects. One is "How a Bill Becomes a Law to Conserve Energy." The other is "U.S. Energy Policy — Which Direction." Both would be relevant for a student Energy Committee preparing a new code. For the class generally, Activity 7 of the first named volume, "Will Slower Speeds Benefit the Environment?" would perhaps be sufficient.

4. **The distribution and exploitations of its energy resources are especially important in Colorado.**

The extraction of coal and metals has been such an important part of the state's story that many sources present a good account of what these resources have meant to people. Student committees dealing with water, land use, and particularly wildlife can address these issues. *Geography of Colorado* (See 1 Air 2.) has relevant chapters on geology, p. 2, and mining, p. 51.

LIFE

1. **The forms of life upon which we depend, primarily for food, are as greatly affected by the ecosystem as we are.**

"Requirements for Life," pp. 77-81 in *Ten-Minute Field Trips** by Helen Ross Russell, suggests both classroom and outdoor activities for demonstrating the environmental impact on those forms of life that provide us with food. See also: the biotic zones and ecological succession sections in "Helping Wildlife,"* p. 8, and pp. 10-12; *Project Learning Tree**, "Why Do Trees Grow There?;" and *We Can Help!**, Guide 4, "Insects and Plants." Insects that consume foliage and the use of insects for the control of noxious plants are described in *Range Science Review**, Vol. 3, No. 2, "Insects and their Impacts on Range Ecosystems." Hear also Vol. 1, No. 8, "Soil Microorganisms in Rangeland."

2. **Wildlife resources are an important element in our economy and recreation, as well as in our appreciation of the beauties of nature.**

The Colorado Division of Wildlife* can supply

two films dealing with this subject. One is "What Good is a Warbler," 15 minutes showing the intricate relationship of wildlife with other elements of the natural environment. The other film is "Wildlife American Heritage," 17 minutes showing the competition for habitat and resources. Two series of pamphlets are available for students to read. The Extension Service* in Colorado offers "Exploring Wildlife," 67 cents; "Small Game and Waterfowl," $1.17; "Big Game and Furbearers," 61 cents; "Songbirds and Birds of Prey," 65 cents. The Colorado Division of Wildlife* issues booklets on fishes, furbearers, game animals, and game birds, all Colorado species. See also *Project Learning Tree**, "The Value of Wildlife."

3. **These effects upon people can be illustrated through the study of local wildlife whether your school is in an urban or rural setting.**

The Soil Conservation Service* issues a pamphlet of 16 pages, nearly all photographs, that would be a good introduction to whatever the nearest wildlife to your school may be. It is titled "More Wildlife Through Soil and Water Conservation," and is available free from the nearest office of the Service. The variety of wildlife species and their numbers can be located, identified and quantified within a given radius of the school or town. Drawings of each animal spotted is an extension of this assignment into art; the art collection assembled as a mural lends itself as a display under such headings as "Wildlife of _____, by the Students of the _____ School."

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Concept 3
Grades 10-12

HUMAN BEINGS ARE NOW THE MOST INFLUENTIAL OF EARTH'S ORGANISMS

Understanding Human Impacts on the Environment

1. **Changes people bring about in an ecosystem are perceived differently by different groups and individuals.**

The point can be demonstrated in the classroom by having students discuss any one of several fairly common situations. One focus for student discussion might be a showing of the film, "This Land Is Your Land," 27 mintues produced by the National Wildlife Federation* and on loan from the Division of Wildlife*. Students can give their views of the problems raised either in written form, oral discussion, or drawings.

An alternative, with similar options for student reaction, is the EME notebook* Uses — Activity 6, "Energy Costs in Pollution Reaction;" Uses — Activity 8, "Energy Costs in Pollution Reduction;" Impacts — Activity 8, "Freedom of Choice vs. Energy Conservation Programs;" Conversions — Activity 7, "Benefits and Problems of Conversion Technology;" and Future — Activity 9, "Energy and the Economy."

2. **In our interventions in natural processes, we act on the basic tenet of justice: innocent until proved guilty. Is this still valid in ecology?**

This could be the subject of an open-ended class discussion. Students will have their own ideas of how far projects that impact on the environment should be controlled. They might be helped if they first undertake *Project Learning Tree**, "Impact Statement."

3. **The impact of human intervention upon the natural resources of the state or the area in which you live can be studied as a case in point.**

A case in point is provided in an activity on paper and waste, in *Project Learning Tree**, "Would You Like That Wrapped?" Students in teams of three to five study the problem in the local shops. Variations and extensions are suggested.

Other resources are *Project Learning Tree**, "Pollution Search" and "Sense of Knowledge," and the EME notebook* Conversion — Activity 3, "Accommodation of Waste Products."

A different type of human impact can be seen on a field trip to any National or State Park or Forest*. Colorado has a great many of them, and all are testimony to the desire of people to intervene constructively in the natural environment. Write in advance for an appointment.

WATER

1. **In satisfying our needs for fresh water, we changed the natural flow so greatly that original courses often are unrecognizable. Colorado offers many examples.**

The films, "The Problem with Water is People" and "Brown Trout, Yellow Bulldozers, and Black Asphalt," both available from the Division of Wildlife*, offers starting points. The first follows the course of the Colorado River and includes graphic examples of pollution. What is done to clean the water could then be analyzed in various ways — such as simulating environmental impact statements written in past and future times. The second film shows the other side of human intervention in water resources, the diversion and resurrection of Ten Mile Creek. Explore how the process at Ten Mile might be modeled elsewhere.

2. **Water laws determine what happens and who controls the water in large areas of the country.**

A talk to the class by a local lawyer or water conservation district administrator can help to explain this country's history of water legislation and present problems in water use and water laws in Colorado. A film made by Station KOA-TV, Denver, "The Land Grants of the San Luis Valley," shows how water rights were acquired — and lost. Residents of the Valley discuss and explain the action. It is available on receipt of $10 and a blank TV cassette from the Denver Public Library, 1357 Broadway, Denver, CO 80203.

How water rights are exercised in the school district or similar local area offers opportunities for student investigation. The League of Women Voters of Colorado has a booklet, "Colorado Water,"* which is useful.

3. **The impacts of human use and re-use of water depend upon the care we take to preserve its quality:**

   A. **With non-degradable wastes from farm and factory;**

   B. **By filtration and purification.**

The Division of Wildlife* *Outdoor Facts*, "Fishery Information Bulletin No. 11 — the Stream Bottom as an Indicator of Pollution," is one in a series of *Outdoor Facts* leaflets published by the Division and available to teachers that proves helpful.

4. **The problems can be reduced to more readily comprehensible proportions by studying the local community's water system.**

A visit to a local water treatment plant and then to a sewage disposal system will provide answers to the first and last questions, what human intervention has done to local resources and where this water comes from and goes to. Before such a field trip, call to be sure someone will be on hand to explain and answer student questions. Then be sure to ask your tour guide what the big problems are. If the visit cannot be arranged, you might invite the manager of the water company to talk at the school. If a student Water Committee has been formed, it should extend this study to learn what future water needs are likely to be and what plans are being made to meet them.

For the effects on aquatic and other wildlife, the film "So Little Time" (Division of Wildlife*) is a valuable teaching aid. The 28-minute documentary shows mainly what happens to waterfowl, the threats to their existence. Either by surveys or library research, students can see how much of this applies to the wildlife in your area.

AIR

1. Pollution of air by people's wastes, machines, and manufacturing processes is a problem of long standing.

The section air pollution is the unit "Waste Management" of *Geography in an Urban Age** covers many aspects of the problem. *Save the Earth** by Betty Miles deals with the issue well in the section on air, pp. 33-53 (Alfred A. Knopf, 201 East 50th St., New York, NY 10022, $2.50). Various types and reactions of air pollution and the effects on rangeland are discussed in *Range Science Review**, Vol. 3, No. 5, "Air Pollution Effect on Rangeland Ecosystems."

2. Efforts to prevent or reverse pollution are also part of our impact on the environment.

See in *Save the Earth* mentioned in the previous paragraph "Taking Action — The Story of Pittsburgh and the Long Clean-Up," pp. 42-44. For independent work, student teams might research what other big cities have done — Denver certainly, Los Angeles, St. Louis, New York, Chicago, Detroit.

3. Local air quality can be analyzed to point up the significance of people's interference with this vital element.

Recent articles in local newspapers will have discussed this subject. Students might also interview officials of such agencies as the health department, air pollution board, and motor vehicle bureau for regulations on car emissions. Someone from one of these agencies might be invited to speak to the students. If a student Air Pollution Committee has been formed, its members should study state and federal regulations on the subject, and proposals for their modification.

SOIL

1. The type of cultivation farmers choose can save or destroy topsoil. (By one method a layer 8 inches thick can grow good crops for 36 years; by another, for 22 centuries.)

Activities in the Soil Conservation Service* publication, *Teaching Soil and Water Conservation,* are especially useful. Study the chapter "Farming in Colorado," p. 37 of *Geography of Colorado**. (See 1 Air 2 above.). *Range Science Review**, Vol. 2, No. 5, "Fertilizers" covers effects of fertilizers on range yield, vigor of plants, nutritional value, and animal patterns.

2. From ancient times, people's use of land caused the rise — and fall — of civilizations.

See the previously cited Soil Conservation Service* pamphlet, "Conquest of the Land Through 7,000 Years." Alternatively use *Project Learning Tree**, "Soil Compaction."

3. Modern land-use proposals often are difficult to resolve because of the effect they will have on soils. Trade-offs often are inevitable.

A set of slides with audio cassette, "Yellow Ore, Yellow Hair, Yellow Pine," dealing with Custer's 1874 expedition to the Black Hills will help make the point. Reprints of photographs taken at the time and new ones taken from the same locations in 1974 vividly document a century of change. An accompanying text explains what happened and how human impacts affected wildlife, natural resources, and the environment. Both the slide cassette and the text with reprints are obtainable from the Division of Wildlife*.

"What's the Use of Land?," a secondary school social studies project developed by the Jefferson County (Colo.) public schools for

the National Aeronautical and Space Administration, $1.45, deals mostly with Colorado but includes other land use studies; see also 'The Story of Portsville' in the "Growth of Cities" volume of *Geography in an Urban Age**.

4. Illustrations from local land use can be found — in conversion of range or swamp or forest to farms, of farms or range to urbanization, or any of these to highways.

*Project Learning Tree**, "Community Land Use" offers useful guidelines. This will be especially important for a student Land Use Committee, whose members can interview local zoning and planning officials, real estate developers, and conservation groups for data on present regulations and future plans. The U.S. Forest Service*, "A Lesson Plan for Investigating an Urban Community" will prove helpful.

See also the EME notebook*, Impacts — Activity 2, "What Type of Shopping Area?"

ENERGY

1. Energy decisions made by one government entity have environmental consequences which may be felt in areas over which that entity has no jurisdiction.

The EME notebook*, Impacts — Activity 9, "Site Review," is an introduction. Students review six categories of the process in siting a power plant. Also Future — Activity 6, "Nuclear Plant Locations" addresses this. Federal, state, and local agencies are involved. The activity calls for 15 more class periods. See also Conversion — Activity 6, "A New Law." A shorter sequence is in *Project Learning Tree**, "Participatory Democracy" and "Where to Plant."

2. The effects of human uses of energy on the environment can be predicted and measured.

"Impact Statement" in *Project Learning Tree** involves students in predicting and measuring the effects of a hypothetical project. As an alternative see the EME notebook*, Impacts — Activity 7, "Future Nuclear Plant Sites." Additional EME activities on this same theme are: Uses — Activity 1, "Population vs. Food: an Energy Problem;" Uses — Activity 8, "Understanding Graphs of Energy Use Relating to Food Production;" Uses — Activity 6, "Energy Costs in Pollution Reduction;" and Impacts — Activity 1, "Predicting Environmental Impacts."

An excellent reading is *Sun Earth**, a well illustrated, well written book by Richard L. Crowther; Charles Scribner's Sons, 597 Fifth Ave., New York, NY 10017.

3. Environmental consequences of people's consumption or production of energy can be studied independently in the local community.

A suggested program for a class study of local energy problems is EME notebook*, Impacts — Activity 11, "Traditional Values and Energy Use Problem Solving." See also *Project Learning Tree**, "Comparison of Insulation Efficiency." A student Energy Committee should go further in interviewing local producers, large consumers, and regulators of energy.

LIFE

1. **Our intervention in the environment has changed original plant and animal distribution, their numbers, and their habitat.**

The positive side, both the danger to wildlife and what is being done to save some animals, is shown in "No Other Side of the Mountain" (Division of Wildlife*). Filmed in Colorado with Frank Currier as host, it portrays in 36 minutes what happens to seven notable Colorado species. A class discussion, essay or art assignment based on this film lends itself to bringing out student views.

For a less optimistic version, you might show "Think Like a Mountain," 27 minutes, the title of which was taken from Aldo Leopold's writings (Division of Wildlife*).

As an alternative see *Project Learning Tree**, "The Continuing Adventures of the Truffle Tree Company." Students explore the questions raised in "The Lorax" by Dr. Seuss. Or from U.S. Forest Service*, "Lesson Plan Outline for Investigating Environmental Habitat." Listen to *Range Science Review**, Vol. 1, No. 12, "Effects of Livestock Grazing on Other Range Land Uses." The cassette discusses bird habitats, interaction of grazing animals, and effects of grazing on watersheds and recreation.

2. **People apply scientific knowledge to managing plant resources — cultivated crops most obviously, but forest, marsh, and prairie, too.**

For the effective management of grasslands, see "Native Grasses," Bulletin No. 450A, Extension Service*, Fort Collins. An older and more detailed treatment is "Colorado Range Management Handbook." In *Project Learning Tree**, "Environmental Editorial" or "Who Runs This Place?" *We Can Help!**, Guide 1, "Plants and Places?" will prove helpful. A discussion on population trends and resulting increased demands for food with emphasis on energy requirements for food production is recorded in *Range Science Review**, Vol. 4, No. 12, "Population and World Wide Food and Energy Demands."

3. **Wildlife managers also apply scientific knowledge to the improvements of habitat in the interest of animals as well as of people.**

The impact of wildlife management on the animals it is supposed to help is graphically and clearly explained in the Soil Conservation Service* 16-page pamphlet, "More Wildlife Through Soil Conservation." Consisting mostly of photographs and drawings, it presents one positive effect on our intervention in the environment. The film, "No Other Side of the Mountain," reinforces the point. (See the previous topic.)

4. **These points can be illustrated by investigating changes in the types of plants and animals in the locality.**

Students might apply the techniques learned or used in 2 and 3 to the plants and animals indigenous to the locality, and to any replacements introduced since settlement. A student Wildlife Conservation Committee should also inquire closely into the reasons for the changes. Some of the Division of Wildlife* *Outdoor Facts*, the Game Information Leaflets, will be useful. Especially see #80, "Glossary of Selected Animal Behavior Definitions," and #62, "Gestation Periods, Litter Sizes, and Breeding Habits of Colorado Furbearers." Single copies are free to teachers. A list of the whole series will be sent on request. "A Lesson Plan for Investigating Forest Environment" from the U.S. Forest Service* inservice workshop also addresses this.

Concept 4
Grades 10-12

OUR ABILITY TO COMPREHEND MUST BE COUPLED WITH THE OBLIGATION OF SELF-CONTROL

Understanding Human Responsibilities and Opportunities

1. Identification of major conservation problems, — awareness of how we use natural resources — is the first step.

If a class brainstorms the question of just what are our major conservation problems, it will see how many come under one of the headings: water, air, soil, energy, life. This might be a good time to organize the mock legislative body if not previously done. Identification of major problems also is a part of the "Waste Management" Activity of *Geography in an Urban Age**. See also *Project Learning Tree**, "A Simple Life," "A Look at Life Styles," and "For Better or For Worse," or the EME notebook*, Impacts — Activities 5, "Lifestyle Choices and Energy Use;" Limits — Activity 3, "Conserving Natural Resources;" and Impacts — Activity 8, "Freedom of Choice vs. Energy Conservation Programs." *The Game*, a simulation on litter developed for Keep Colorado Beautiful*, identifies the causes, hazards, and costs of litter and is designed to change behavior towards waste.

2. Solutions can be reached through accepting stewardship of natural resources for our fellows and for the future.

Just what a sense of stewardship means and what it involves comes out in a game, *Project Learning Tree**, "Participatory Democracy," especially if the activities on "Variations" and "Mining and Renewable Resources" are also used. An alternative choice is the activity 'Enough Food for the World?' in the "Manufacturing and Agriculture" volume of *Geography for an Urban Age** as part of this topic. See also EME notebook*, Impacts — Activities 6, "Unwise Energy Use," and Impacts — Activity 7, "Future Nuclear Plant Site."

3. Extending our stewardship to a concern and a trusteeship for all forms of life is the ultimate step.

*Project Learning Tree**, "Endangered Species" calls for the class to work out the steps needed to save these animals. In the process, our stewardship comes into sharp focus. See also the *Outdoor Facts* leaflets (Division of Wildlife*) as a further resource, and *We Can Help!** Guide 24, "Endangered Species: Mystery Birds."

4. High school is not too soon to start training for stewardship, nor to practice it. Students can serve and learn at the same time.

Training for volunteer work in a conservation

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program is as important as willingness to serve. Working with elementary and junior high students as part of a class and school program builds leadership and respect. Several aids to the schools are available in this field. They include:

The National Student Volunteer Program* is part of ACTION. Teachers interested in specific ideas for developing volunteer training programs can call the Washington office, toll free, 800-424-8580, Extension 89. The agency will also send free to any teacher requesting it, its magazine *Synergist*, an illustrated quarterly of 60 to 70 pages devoted to volunteer training, many of the articles dealing with environmental possibilities. The agency also has examples of what students in various parts of the country have done as volunteers, sometimes on behalf of the environment.

The Kellogg High School Program of the National Information Center on Volunteerism* has helpful suggestions to teachers. Resources in Colorado include: Clearing Houses for Youth in Adams County, Arapahoe County, Boulder, Colorado Springs, Denver, Jefferson County, and Longmont. County extension services*, local service clubs, and the Junior Leagues of Denver and Colorado Springs are further resources for places volunteers can serve locally.

The Youth Conservation Corps*, a work, earn, learn summer program on federal and state lands, is also a resource; applications are mailed to all schools. Volunteer youth conservation activities* offer a wide variety of work experiences in National Parks and Forests* and in other locations without pay.

WATER

1. **Management of water resources is a governmental function. It is carried out nationally by federal agencies under Acts of Congress.**

Students might research the responsibilities and activities of the various federal bodies that are concerned with water. A student might begin an investigation, by writing to each of these agencies for a leaflet, brief statement or other information on its role in water supplies and water conservation. The investigation can be given to the student Water Committee of the mock legislature. Reports can be shared with the class. Brainstorming sessions on the whole governmental process in this essential area of our lives can lead to identifying citizen responsibilities.

A field trip to a dam or reservoir — completed, under construction, or projected — selected, planned and arranged (with teacher coordination) would reinforce this lesson, as well as the one that follows.

2. **The state has similar responsibilities, laws, and agencies.**

Similarly, students can learn about the state's role, e.g. Colorado Water Conservation Board and the Colorado Division of Water Resources. An additional resource here would be the Colorado Water Congress*, although it is not a governmental agency.

3. **Conservation requires difficult decisions. For example, if Denver cut its water use in half and held its savings in reserve, people downstream who depend on the city's recycled water would be parched.**

"Water Balance" in the volume on "Habitat and Resources" of *Geography in an Urban Age** has a general approach. Or students might investigate a recent, present, or proposed water project near them. Then let them discuss or write on the problems of priorities and the trade-offs involved. Also they might

investigate what any private group or businesses are doing about water. This would be especially relevant to the work of a student Water Committee. The procedures involved in preparation of an environmental impact statement can be adapted to water use decisions. See *Project Learning Tree**, "Impact Statements."

4. The conservation lesson can be learned at first hand from the local water situation.

You may wish to invite the head of the local water company or water conservation board to address the students or arrange a study visit to the local water works. How adequate does the expert consider the supply, and what are the plans for safeguarding or expanding it? If a student Water Committee is active, it should pursue these subjects in depth.

An individual and class project for actually conserving water is *Project Learning Tree**, "Water We Doing?" Students undertake to use less water in their daily routines, and measure the savings.

Other resources include U.S. Forest Service* Workshop, *Environmental Education for Teachers and Resource People*, "A Lesson Plan for Measuring Some Water Quality Criteria" for a study of local water supplies. Also see *We Can Help!**, Guides 2, "Water Flow and Impoundment," and 10, "Water Quality Analysis."

AIR

1. We might be tempted to paraphrase Charles Warner's remark about the weather and say, "Everybody talks about air pollution but nobody does anything about it." We would be wrong. Experts disagree about how much is being done and how effectively, but it is there.

Just what people are doing about it might emerge by assigning the class to research the subject and report, perhaps in teams working on various aspects. Sources they might use would include the local health department, a local air pollution control office whether governmental or private, *Save the Earth** (especially the chapter on Pittsburgh), the *Reader's Guide to Periodical Literature*, and *Geography in an Urban Age** (the last volume's section on air pollution).

2. Some regulations apply in your community, and private individuals and companies are working toward strengthening or weakening the rules.

An approach to the question based on the role of trees in keeping our air clean is *Project Learning Tree**, "Johnny Appleseed on Mars." Another, more direct method is to have students in teams or individuals interview officials of the local air pollution board if one exists, health department, motor vehicle bureau, and safety inspectors on what is being done. A large study is the air pollution section of "Waste Management" in *Geography in an Urban Age**.

Interviews conducted by the student Air Pollution Committee of local businessmen, city council members, and members of private conservation agencies would help to identify strengths and weaknesses. The same agencies identified in the preceding "Resources" suggestions usually have the rules and regulations. Newspaper files also might be consulted, and *Project Learning Tree**, "How Clean is Clean?" examines the possible trade-offs involved when stricter pollution control standards are posed or imposed.

SOIL

1. **Practices that conserve and even improve soil are widely known but not always observed.**

*Project Learning Tree**, "Where Are the Cedars of Lebanan?" lends itself to student debates that call for research on the use of land. See also the Soil Conservation Service* pamphlet, "Conquest of the Land Through 7,000 Years" for the preservation and abuse of soil through the ages. The influence of the soil as a factor in the Stone Age, Egypt, India, and Mesopotamia can be used as a beginning that spreads world wide throughout all of history.

2. **Deciding whether to use land for farming, forest or wilderness, urbanization, extraction, or recreation is the people's responsibility.**

The general principles are il ustrated in a single soil problem in "Sediment," Soil Conservation Service* pamphlet, 16 pages of good photographs and text explaining the problem of soil that is "filling up harbors, lakes, and roadside ditches." This concept can be extended in brainstorming sessions to other land-use practices. *Project Learning Tree** activities that should prove helpful are "Hard Choices," "Plan Your Community's Future," and "Land Allocation." *Range Science Review**, Vol. 4, No. 5, "Ecological Evaluation in Land Use Planning" orally addresses ecological determinism, inventory of ecosystem components, concepts of stability and diversity, terrain and other factors. Also, Vol. 4, No. 2, "Rehabilitation of Strip Mining Lands in the Arid West" covers planning, rehabilitation, revegetation, moisture conservation and management.

3. **Historically, the use of the land has been unplanned, but there are exceptions: L'Enfant's for the City of Washington, the rebuilding of some bombed-out cities after World War II, green belt, and zoning efforts.**

Students' research on the L'Enfant plan for Washington, D.C., or the decisions involved in rebuilding one of the large bombed-out cities of Europe after World War II would make the point as would examining new cities planned and built in Holland, England, Sweden, and Japan. How were these competing interests reconciled: Open or green space, residential, commercial, industrial, transportation, recreation? Students do this as part of the activity, 'The Story of Portsville', in the "Growth of Cities" volume of *Geography in an Urban Age*.

Other resources include *We Can Help!**, Guides 11, "Public Use of Public Land," and 20, "Public Survey," and U.S. Forest Service*, "A Lesson Plan for Soil Investigations in Land Use Planning" in which students use local sites in a study to develop hypotheses.

4. **A study of local land use and regulations governing it will illustrate the problems.**

Pictures and stories that portray the changing use of land in the community from its early settlement can be assembled and presented by students. Such art work supplemented by their own drawings can be mounted as a mural to depict the local history. To make the pictures meaningful and get them in proper sequence, students should discuss the influences that caused changes. What would students like to see changed now? This should be the special concern of a student Land Use Committee. Members of local zoning and planning boards might be invited to address the students. Representatives of the class might attend a few zoning or planning board sessions and report back to their colleagues.

An alternative is a students' designed new addition to their own community. Assume a large research center is to be established with

500-1,000 employees — a nonpolluting enterprise. Where should it and the houses and shops to serve its workers be placed to provide the least expropriation of good farm land, least interference with present land uses, least impact on the environment? Students should work in teams of three to five for best results. Their completed efforts might make an attractive, informative school exhibit.

The procedures used in the U.S. Forest Service*, "Lessons Plan for Investigating an Urban Community," can be easily adapted. Zoning regulations are key to *Project Learning Tree**, "Urban Open Space."

ENERGY

1. People can use nature's efficient energy systems in order to reduce energy consumption.

The EME notebook*, Uses — Activity 2, "Water as an Energy Source," makes the point. This could be linked in the classroom to a discussion of the possibilities of hydrogen from the ocean as an inexhaustible energy source, admittedly remote but the subject of current research. Alternatives are Uses — Activity 5, "Space Heating, What's Best?" designed for all subjects; Sources — Activities 5 and 6 "Home Energy Sources," and "Energy for Energy." Man and his niche in the ecosystem and manipulation of the ecosystem for increased biological efficiency are explained in *Range Science Review**, Vol. 1, No. 3, "Energy Flow in the Range System." Also listen to Vol. 4, No. 8, "Energy Resources and Land Management in the West" which projects the interrelations of range forage, fossil fuels, and food in a land management program for the future.

2. Value decisions and the cost/benefit economics of energy consumption govern the efficiency of our energy use and our search for alternative renewable sources.

The EME notebook*, Uses — Activity 8, "Understanding Graphs of Energy Use Relating to Food Production," deals with various value decisions after students have read the article included with the activity, "U.S. Agriculture Growing Trouble as Well as Crops" by Wilson Clark. Students also examine graphs relating to food production, and this leads them to consider not only efficient use of present resources, but the possibilities for new ones. A more general approach to the problem is Uses — Activity 6, "Energy Costs in Pollution Reduction." A good field trip in this connection would be to The Transportation Test Center* in Pueblo where research into the latest in railroading is being conducted. Write for descriptive leaflet when making the appointment. See also *Project Learning Tree**, "A Treasure Hunt for Energy," and EME notebook*, Conversions — Activity 8, "Technology and Transportation" and Impacts — Activity 4, "Environmental Impacts and Transportation."

3. Energy conversion processes are of unequal efficiency, but efficiency is not always our chief consideration. We usually practice conservation only when the alternative is unpleasant.

See the EME notebook*, Conversion — Activities 6 and 7, "A New Law," and "Benefits and Problems of Conversion Technology." Observations at The Transportation Test Center*, if that field trip is taken, will also apply here. *Project Learning Tree**, "...And a Side Order of Paper" examines the problem from the humble viewpoint of wrapping for a hamburger. Other resources are EME notebook*, Sources — Activities 2 and 3, "Energy Uses in Providing Food," and "Energy Used in Providing Shelter."

4. **Local energy resources and problems illustrate these issues, especially if students engage in conservation activities at home, in school, and as volunteers in the community.**

In *Project Learning Tree**, "You've Come a Long Way, Maybe," students study the energy consumed by home appliances and work out ways to reduce the use of these conveniences. They also measure the savings. An alternative giving a similar approach is outlined in the EME notebook*, Uses — Activity 9, "The Costs of Reducing Energy Consumption." See also Impacts — Activity 8, "Freedom of Choices vs. Energy Conservation Programs" and Uses — Activity 11, "Our Leisure Time Activities."

A student Committee on Energy for drafting a model code should also interview the manager or an engineer of the local power plant, a member of any local energy conservation organization, city or county officials charged with community growth, an active Chamber of Commerce member, an automotive engineer and dealer, an engineer in the highway department. They should be asked not only about current problems but about energy needs for future growth of the community. Study of Crowther's chapters "Building Design for Energy Organization" and "Economics" in *Sun Earth** might be considered in drafting a code.

LIFE

1. **The degree to which we practice conservation can determine the fate of human species. Survival requires the adaptability that wise use of natural resources entails.**

A good start is to have students read one of the essays in *A Sand County Almanac* by Aldo Leopold — one of the "Sketches Here and Now" or "The Upshot." Then let them write their own versions of what will happen to us if we fail to adapt to our natural resources. Also worthy of student examinations is Leopold's renowned *Game Management.* Will we become as overspecialized as the dionsaurs and suffer the same fate, or as adaptable as the prairie dog? See *Project Learning Tree**, "How Much is Enough?" and "A Simpler Life."

2. **People's intervention in the environment imposes on us an obligation to maintain, restore, and enhance it, applying the principle that in nature diversity generates stability and strength.**

"Decisions," a 17-minute film narrated by John Wayne, describes the achievement of Ducks Unlimited in restoring a habitat that benefits more than 300 species of wildlife. Another good film is "Bucks and Bulls — Colorado Style," 27 1/2 minutes, on the needs of wildlife, which are the same as those of people, and why wildlife management is needed. Both are on loan from the Division of Wildlife*. Aldo Leopold's *Game Management* focuses on theory and techniques. Students could explore what constitutes effective management and present their findings orally, in writing, in an art form or in a scientific presentation. Protection of habitat, hunting and fishing regulations, and funding for wildlife conservation, maintenance and enhancement should be studied and considered.

If possible, invite your district wildlife manager to talk to the students. For further references, see "Helping Wildlife,"* pp. 17-24 which addresses placing American wildlife in perspective, or, for Colorado specifically, *Today's Strategy ... Tomorrow's Wildlife,* a 96-page illustrated brochure of the Division of Wildlife*, $3.

Other resources include *Project Learning Tree**, "Wildlife Habitat," "Endangered Species," and "Plan a Trip."

3. A special role for high school students can be tutorial, helping to teach conservation principles to children in lower grades.

Where high school students have served effectively as tutors for children in the primary grades, it has usually — although not always — been by arrangement worked out among the teachers and administrators of the two schools concerned and high school students who volunteer for the program.

Volunteers. If students have served as volunteers in conservation or environmental work in the community, or the class has carried out a special project (as a result of activities such as are suggested in 4 Energy 4 above), they should be encouraged to share the experience with classmates and the rest of the school. Individual volunteers can benefit the program and the classmates by sharing reports on the nature of their work, the need for it, and the results. If juniors do volunteer work during the summer, ask them to make the reports early in the next term. These reports and progress on any class project might be published in the school paper, and the local news media should be informed of class projects.

4. A survey of the needs of agriculture, grasslands, forest, plantlife, and wildlife nearby or throughout Colorado will illustrate how our ability to comprehend can be coupled with our obligations.

This quality indicator should be illustrative of the general principles of all education in natural resources, conservation, and environment. Water that kills fish, air that is unfit for the flight of birds, soil for plants or animals that is infertile (or lost) serve as a barometer of the quality of environment for humankind.

An acute awareness of the finiteness of planet Earth is developed as one of seven principles in *Project Learning Tree**. The organization of the materials are designed around these principles to help students build skills and knowledge so that they can evaluate their own life styles, particularly in relationship to the finiteness our our resources.

Supporting documentation on Earth's finiteness is vividly presented in the "Limits To Growth" film based upon the Club of Rome's study on the present and future problems confronting humankind. Contact the Division of Wildlife* for loan of the film.

Albert A. Bartlett speaks effectively to the problems created by exponential growth in his presentations and paper on "The Forgotten Fundamentals of the Energy Crisis." Write Dr. Bartlett, Department of Physics and Astrophysics, Duane Physics Building, E032, University of Colorado at Boulder, CO 80309.

The Model Code. As in all other areas of conservation, if a student committee is formed on agriculture and grasslands or forests, plantlife and wildlife, its members should research additional data with fair representation to all views. The wildlife aspect lends itself to involvement of district wildlife managers. They can help in the study of hunting, fishing and trapping, as well as the acquisition of new land for wildlife habitat, natural areas and other programs.

All student committees should have access to current Colorado laws dealing with conservation. Sessions in which committee reports are debated and a "model code" approved — or rejected — can be flexible. So far as possible, floor rules should be set by the students. A selection of federal and state laws is attached as Appendix C.

APPENDIX A

Sources Suggested in Resources Sections

Following are the names and addresses of agencies, publications, programs, and organizations indicated by an asterisk (*) in the "Resources." Where prices are given, they are those prevailing when the Model was completed and are subject to change by the publishers or distributors.

American Humane Association — Contact AHA at 5351 S. Roslyn, Englewood, CO, 80110.

Audubon Society — See National Audubon Society.

Better Environment — See Soil Conservation Society of America.

"Beyond the Classroom" — Write Keystone Center for Continuing Education, Environmental Education, Box 38, Keystone, CO 80435.

Bureau of Land Management — Write to Colorado State Office, U.S. Bureau of Land Management, 1600 Broadway, Denver, CO 80203.

Bureau of Reclamation — Write to Public Affairs Office, Building 20, Denver Federal Center, Denver, CO 80225.

Captain Hydro — Write Colorado Water Congress, World Savings Building, Suite 401, 1111 S. Colorado Boulevard, Denver, CO 80222.

Colorado Cooperative Extension Service — Check for County listing in the telephone book or write Colorado State University, Ft. Collins, CO 80523.

Colorado Division of Parks and Outdoor Recreation — Contact Environmental Education Coordinator, 1313 Sherman, Denver, CO 80203.

Colorado Division of Wildlife — See Division of Wildlife.

Colorado EME — EME notebooks consist of four volumes, one each for Grades 1-3, 4-6, 7-9, and 10-12. Reference to them in the Model are to the appropriate grade level volume unless otherwise noted. The notebooks are obtainable to school districts through inservice. For information on inservice contact Jon R. Thompson, Colorado Coordinator, Energy and Man's Environment, Inc., 2417 Warwick Lane, Colorado Springs, Colorado 80909 (telephone number, 635-6491). EME notebooks may be purchased separately. The cost is $24.00 per volume from the national headquarters of Energy and Man's Environment, 0224 S.W. Hamilton, Suite 301, Portland, OR 97201.

"Colorado Water" — Contact local League offices or send $2.00 for the booklet to League of Women Voters of Colorado, 1600 Race, Denver, CO 80206.

Colorado Water Congress — Contact CWC at World Savings Building, Suite 401, 1111 S. Colorado Boulevard, Denver, CO 80222.

"Conquest of the Land Through 7,000 Years" — See Soil Conservation Service.

Cromar's Audio Visual Center — Write Cromar's Inc., 1200 Stout St., Denver, CO 80204.

Denver Water Department — Write 1600 W. 12th Avenue, Denver, CO 80254.

Department of Energy — For the material prepared by the National Science Teachers Association for the U.S. Department of Energy write: Technical Information Center, Department of Energy, P.O. Box 62, Oak Ridge, TN 37830.

Division of Wildlife — Write to Film and Curriculum Library, Conservation Education Services, 6060 Broadway, Denver, CO 80216. Films are often booked for months in advance, so give as much notice as possible, and alternate dates.

Energy and Man's Environment EME notebook — See Colorado EME.

Enos A. Mills Homestead Cabin — The Mills Homestead is the site of the founder of Rocky Mountain National Park, open to the public, self-guided nature trail, books, letters, documents, photographs and mementos reflecting the diversity of Enos A. Mills' life, contributions and times. Write Enos Mills Cabin, c/o Edna Mills Kiley, Longs Peak Route, Estes Park, CO 80517.

Environmental Respect — by Albert R. Huck and Eugene Decker — Write Safari Club International Conservation Fund, 877 S. Alvernon Way, Tuscon, AZ 85711.

Exploring Your Environment, "The Strand Approach," — Contact Silver Burdett, 250 James Street, Morristown, NJ 07960.

Extension Service, Fort Collins — See Colorado Cooperative Extension Service.

"The Forgotten Fundamentals of the Energy Crisis" — Write Dr. Albert A. Bartlett, Department of Physics and Astrophysics, Duane Physics Building, E032, University of Colorado, Boulder, CO 80309.

The Game — Write Keep Colorado Beautiful, 4260 E. Evans, Denver, CO 80222.

Geography in an Urban Age — This National Science Foundation curriculum project published by MacMillan is now in the public domain. Schools that have copies may reproduce any of it freely by writing to the Association of American Geographers, 1710 Sixteenth Street, N.W. Washington, D.C., 20009.

Geography of Colorado by Joy Clapp and Paul C. Stevens — Purchase for $2.00 from the Old West Text Books, Johnson Publishing Co., 839 Pearl Street, Boulder, CO 80302.

Goode's World Atlas, Edited by Edward B. Espenshade, Jr. — Rand McNally and Co., 8255 N. Central Park Avenue, Skokie, IL 60076.

"Helping Wildlife" by Delwin E. Benson — Purchase for $1.00 from Wildlife Management Institute, 709 Wirl Building, 1000 Vernon Avenue, N.W. Washington, D.C. 20005.

Interdisciplinary Student/Teacher Materials in Energy, the Environment and the Economy — See Department of Energy.

Keep Colorado Beautiful — Call 757-2272 or write 4260 E. Evans, Denver, CO 80222. 80222.

Mills Cabin — See Enos A. Mills.

National Audubon Society — Contact Rocky Mountain Regional Office, 4150 Darley Avenue, Boulder, CO 80303, or National Headquarters, 950 Third Avenue, New York, NY 10022.

National Center for Atmospheric Research (NCAR) — Write to Public Information Department, Box 3000, Boulder, CO 80303. For films, give at least 3 weeks notice and alternate dates. For field trips, allow at least two weeks notice.

National Information Center for Volunteerism — Colorado Building, Boulder, CO 80302.

National Parks Service — Use the telephone directory under U.S. Government, Department of Interior for the National Monument or Park nearest you, or write Office of Public Affairs, 655 Parfet, Box 25287 (DFC), Denver, CO 80225.

National Parks and Monuments — See National Park Service.

National Student Volunteer Program — Write c/o ACTION, 806 Connecticut Avenue, N.W., Washington, D.C. 20525. (Particularly in their publication refer to the volume on "High School Courses with Volunteer Components," and "Students in an Ecology Course Work on Community Environmental Problems.")

National Wildlife Federation — Write 1412 Sixteenth Street, N.W. Washington, D.C. 20036.

Nature Bulletins — See National Audubon Society.

NCAR — See National Center for Atmospheric Research.

OBIS *(Outdoor Biology Instructional Strategies)* — Write Lawrence Hall of Science, University of California, Berkeley, CA 94720.

"Outdoor Classrooms on School Sites," PA-975 — See Soil Conservation Service.

Plains Conservation Center — For appointment write to Evan E. Obrecht, 4822 S. Parker Road, Aurora, CO 80015.

Prairie, Peak and Plateau: A Guide to the Geology of Colorado by John and Halka Chronic — $4.00. Write for quantity discounts, Colorado Geological Survey, Room 715, 1313 Sherman, Denver, CO 80203.

Project Learning Tree — Two "Supplementary Activity Guides" are available to teachers through inservice. References to *Project Learning Tree,* unless otherwise stated in the "Resources" volume, are to the "Supplementary Activity Guide For Grades K through 6" in the Model's K-3 and 4-6 sections, and to the 7-12 volume in the Model's 7-9 and 10-12 section. For further information about the *Project Learning Tree* materials and teacher training workshops, contact Conservation Education Services, Colorado Department of Education, State Office Building, 201 East Colfax Avenue, Denver, CO 80203 or telephone 839-2417.

Range Science Review Audio Cassette Tape Program — Write Range Science Department, Colorado State University, Fort Collins, CO 80523. These cassettes are suitable for students especially interested in technical, very specific topics and for the teacher in preparation for instruction. Cassettes may be purchased at $5.00 each by writing to the above address or borrowed from the Division of Wildlife, Film and Curriculum Library.

Ranger Rick — See National Wildlife Federation.

Safari Club - *See Environmental Respect.*

Save the Earth by Betty Mills — Purchase ($2.50) from Alfred A. Knopf, 201 E. 50th Street, New York, NY 10022.

SCIS Kits — The *Science Curriculum Improvement Study* is published by Rand McNally. Contact the Colorado Rand McNally representative or write School Department, Rand McNally and Co., Box 7600, Chicago, IL 60680.

Soil Conservation Service — Call your local Soil Conservation Office (under U.S. Department of Agriculture in the phone book) or write to U.S. Soil Conservation Service, P.O. Box 17107, Denver, CO 80217.

Soil Conservation Society of America — 7515 E. Ankeny Road, Ankeny, Iowa 50021. The *Better Environment* booklets are 35 cents each single copies; Teacher's Guides, 25 cents; bulk rates on request.

"Strand Approach" — See National Park Service and *Exploring Your Environment.*

Sun Earth by Richard L. Crowther — Purchase ($8.95) locally or from Charles Scribner's Sons, 595 Fifth Avenue, New York, NY 10017.

Teaching Soil and Water Conservation — See Soil Conservation Service.

Ten-Minute Field Trips by Helen Ross Russell — Doubleday & Co., Inc., 245 Park Avenue, New York, NY 10017.

The Transportation Test Center — Write Federal Railroad Administration, the Transportation Test Center, Pueblo, CO 81001.

U.S. Bureau of Reclamation — See Bureau of Reclamation.

U.S. Extension Service — See Colorado Extension Service.

U.S. Forest Service — Use the telephone directory to locate the nearest district office (under U.S. Government, Department of Agriculture, Forest Service) or write to Office of Information, U.S. Forest Service, Box 25127, Denver, CO 80225.

Volunteer Youth Conservation Activities — In addition to the National Student Volunteer Program, students may select others.

Volunteers in the National Forest — Work is available, without pay, through formal application and contract agreement on U.S. forests. Applicants under 18 must have written consent from the parent or guardian. Inquire at the nearest U.S. Forest Service Office for information and application, or write U.S. Forest Service, Rocky Mountain Region, 11177 W. 8th Avenue, Box 25127, Lakewood, CO 80225.

Volunteers in the Park serve in a variety of fields, i.e., interpretations; living history; arts and crafts; history, archaeology and natural science; environmental studies and resource management. Application is made directly to the nearest Monument or Park. Those between 16 and 18 must live at home and have parent or guardian written consent.

We Can Help! — A pamphlet of 24 "Indoor and Outdoor Environmental Experiences" with a user's guide developed by the U.S. Fish and Wildlife Service. Costs $15.50 from Jenny Publishing Company, 57 Queen Avenue, Minneapolis, MN 56406.

Wildlife Division — See Division of Wildlife.

Wildlife Management Institute — See "Helping Wildlife."

Yellow Ore, Yellow Hair, Yellow Pine — Bulletin 616 — Purchase from Agricultural Experimental Station, South Dakota State University, Brookings, SD or for loan of the photographic study, tapes and slides write Colorado Division of Wildlife.

Youth Conservation Corps — This summer work/earn/learn program on Federal and State lands is open to young adults ages 15-18. YCC is administered by five Bureaus within the U.S. Department of Interior, The U.S. Department of Agriculture — Forest Service and the Colorado Division of Parks and Outdoor Recreation. All secondary schools are furnished recruitment packages in mid-winter. The annual selection is made by lot through the Colorado Division of Employment and Training, 251 E. 12th Avenue, Denver, CO 80203.

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APPENDIX B

Addresses For Additional Information And Material

A comprehensive catalogue of sources of information about conservation and its various aspects and ramifications would run to more pages than are contained in this Model. For those who wish to go into more detail, however, the following list may be helpful.

AMERICAN FOREST INSTITUTE, 1619 Massachusetts N.W., Washington, DC 20026, publishes *Green America* and co-sponsors *Project Learning Tree.*

AMERICAN FORESTRY ASSOCIATION, 1319 - 18th Street, N.W., Washington, DC 20036, publishers *American Forests* (monthly periodical).

AMERICAN WILDERNESS ALLIANCE, 4260 E. Evans Ave., Denver, CO 80222.

ASPEN CENTER FOR ENVIRONMENTAL STUDIES, Hellan Lake, P.O. Box 8777, Aspen, CO 81611.

BOONE AND CROCKETT CLUB, c/o Carnegie Museum, 4400 Forbes Avenue, Pittsburgh, PA 15213.

COLORADO ASSOCIATION OF SOIL CONSERVATION DISTRICTS, 2760 W. 5th Avenue, Denver, CO 80204.

COLORADO DEPARTMENT OF EDUCATION, State Office Building, 201 E. Colfax Avenue, Denver, CO 80203.

COLORADO DEPARTMENT OF NATURAL RESOURCES, 1313 Sherman, Denver, CO 80203.

COLORADO FEDERATION OF GARDEN CLUBS, INC., 1556 Emerson, Denver, CO 80218.

COLORADO GEOLOGICAL SURVEY, 1313 Sherman, Denver, CO 80203.

COLORADO MOUNTAIN CLUB, 2530 W. Alameda Avenue, Denver, CO 80219.

COLORADO OPEN SPACE COUNCIL, INC., 2239 E. Colfax, Denver, CO 80206.

COLORADO OUTDOOR EDUCATION CENTER, Florissant, CO 80816.

COLORADO SOIL CONSERVATION BOARD, 1313 Sherman, Denver, CO 80203.

COLORADO STATE FOREST SERVICE, c/o Colorado State University, Ft. Collins, CO 80523.

COLORADO WILDLIFE FEDERATION, INC., 5725 St. Vrain Road, Longmont, CO 80501.

CONSERVATION EDUCATION SERVICES, c/o Colorado Department of Education, State Office Building, 201 E. Colfax Avenue, Denver, CO 80203.

THE CONSERVATION FOUNDATION, 1717 Massachusetts Avenue, N.W., Washington, DC 20036, publishes the *C F Letter* (monthly newsletter).

CONSERVATION LIBRARY, c/o Denver Public Library, Main Building, 1357 Broadway, Denver, CO 80203.

COUNCIL ON ECONOMIC PRIORITIES, 456 Greenwich Street, New York, NY 10013.

DEFENDERS OF WILDLIFE, 2000 N Street N.W., Washington, DC 20036, publishes *Defenders of Wildlife News* (newsletter).

DENVER MUSEUM OF NATURAL HISTORY, Education Department, City Park, Denver, CO 80205.

DENVER ZOOLOGICAL GARDENS, City Park, Denver, CO 80205.

DUCKS UNLIMITED, P.O. Box 66300, Chicago, IL 60666, publishes *Ducks Unlimited Magazine.*

ENVIRONMENTAL ACTION, INC., Room 731, 1346 Connecticut Avenue N.W., Washington, DC 20036, publishes *Environmental Action* (bi-monthly newsletter).

ENVIRONMENTAL DEFENSE FUND, INC., 162 Old Town Road, East Setauket, NY 11733.

ENVIRONMENTAL PROTECTION AGENCY, 1860 Lincoln Street, Denver, CO 80295.

THE ERIC CENTER FOR SCIENCE, MATHEMATICS, AND ENVIRONMENTAL EDUCATION, College of Education and School of Natural Resources, Ohio State University, 1200 Chambers Road, Columbus, OH 43212.

ESSENTIA FILM PRODUCTIONS, Salina Star Route, Boulder CO 80302, (Telephone: 443-3484).

FOREST HISTORY SOCIETY, INC., P.O. Box 1531, Santa Cruz, CA 95060, publishes *Forest History* (quarterly).

FRIENDS OF THE EARTH, 529 Commercial Street, San Francisco, CA 94111, publishes *Not Man Apart* (bi-monthly newspaper).

HERITAGE, CONSERVATION AND RECREATION SERVICE, P.O. Box 25387 (DFC), Denver, CO 80225.

IZAAK WALTON LEAGUE OF AMERICA, 1800 North Kent Street, Arlington, VA 22209, publishes *Outdoor America;* Colorado Division, P.O. Box 127, Colorado Springs, CO 80909.

LEAGUE OF CONSERVATIVE VOTERS, 620 C Street, S.E., Washington, DC 20003.

LEAGUE OF WOMEN VOTERS OF THE U.S., 1730 M Street N.W., Washington, DC 20036, publishes *The National Voter.*

MOUNTAIN VIEW CENTER FOR ENVIRONMENTAL EDUCATION, 1511 University Avenue, Boulder, CO 80309.

NATIONAL AUDUBON SOCIETY, 950 Third Avenue, New York, NY 10022, publishes *Audubon* (monthly periodical); Rocky Mountain Regional Office, P.O. Box 3557, Boulder, CO 80307.

NATIONAL PARKS AND CONSERVATION ASSOCIATION, 1701 - 18th Street, N.W., Washington, DC 20009, publishes *National Parks & Conservation Magazine* (monthly periodical).

NATIONAL RESOURCES COUNCIL OF AMERICA, Suite 911, 1025 Connecticut Avenue, N.W., Washington, DC 20036.

NATIONAL WILDLIFE FEDERATION, 1412 - 16th Street N.W., Washington, DC 20036, publishes *National Wildlife, Ranger Rick,* (magazines) and *Conservation News* and *Conservation Report* (newsletters).

THE NATURE CONSERVANCY, Suite 800, North Kent Street, Arlington, VA 22209; Colorado Office, 820 Sixteenth Street, Suite 420, Denver, CO 80202.

OUTWARD BOUND, INC., National Office, 384 Field Point Road, Greenwich, CT 06830; Colorado Outward Bound School, 945 Pennsylvania, Denver, CO 80203.

PROJECT LEARNING TREE, Salina Star Route, Boulder, CO 80302.

PUBLIC SERVICE CO. OF COLORADO, c/o Educational Services Unit, P.O. Box 840, Denver, CO 80201.

SAFARI CLUB INTERNATIONAL, Denver Chapter, 1657 S. Sedalia Street, Aurora, CO 80012.

ST. REGIS PAPER CO., 150 E. 42nd Street, New York, NY 10017.

SCIENTISTS' INSTITUTE FOR PUBLIC INFORMATION, 438 North Skinker, St. Louis, MO 63130, publishes *Environment* (monthly periodical).

SIERRA CLUB, 1050 Mills Tower, San Francisco, CA 94104, publishes *Sierra Club Bulletin* (monthly periodical) and *National News Report* (weekly newsletter).

SOCIETY FOR RANGE MANAGEMENT, 2760 W. 5th Avenue, Denver, CO 80204, publishes the *Journal of Range Management and Rangemen's Journal.*

SOCIETY OF AMERICA FORESTERS, Wild Acres, 5400 Grosvenor Lane, Bethesda MD 20014, publishes the *Journal of Forestry.*

SOIL CONSERVATION SOCIETY OF AMERICA, 7515 N.E. Ankeny Road, Ankeny, IA 50021, publishes the *Journal of Soil and Water Conservation* (monthly).

SPORT FISHING INSTITUTE, Suite 503, 719 - 13th Street N.W., Washington, DC 20005, publishes the *SFI Bulletin* (monthly newsletter).

STALKING EDUCATION IN THE WILD, c/o Colorado Outdoor Education Center, Florissant, CO 80816.

TROUT UNLIMITED, 118 Park Street, S.E., Vienna, VA 22180, publishes *Trout Magazine.*

U.S. FISH AND WILDLIFE SERVICE, Denver Service Center, 3900 S. Wadsworth Blvd., P.O. Box 25486 (DFC), Denver, CO 80225.

U.S. GEOLOGICAL SURVEY, Map Sales, Denver Federal Center, Box 25286, Denver, CO 80225.

U.S. GOVERNMENT PRINTING OFFICE, Denver Book Store, Room 117, 1961 Stout Street, Denver, CO 80294.

WESTERN FORESTRY AND CONSERVATION ASSOCIATION, 1326 American Bank Building, Portland, OR 97205.

THE WILDERNESS SOCIETY, 729 - 15th Street, N.W., Washington, DC 20005, publishes *The Living Wilderness* (monthly periodical).

WILDERNESS WATCH, P.O. Box 3184, Green Bay, WI 54303.

WILDLIFE MANAGEMENT INSTITUTE, 709 Wire Building, Washington, DC 20005, publishes *Outdoor News Bulletin.*

THE WILDLIFE SOCIETY, Suite 611, 7101 Wisconsin Avenue, N.W., Washington, DC 20014, publishes the *Journal of Wildlife Management* and *Wildlife Society News;* Colorado Chapter, c/o Department of Fishery and Wildlife Biology, Colorado State University, Ft. Collins, CO 80523.

WORLD FOOD AND AGRICULTURAL OUTLOOK SITUATION BOARD, 14th and Independence Avenue, S.W., Washington, DC 20250.

WORLD WILDLIFE FUND, Suite 619, 910 - 17th Street N.W., Washington, DC 20006.

ZERO POPULATION GROWTH, INC., 343 Second Street, Los Angeles, CA 94022, publishes *Equilibrium* (periodical) and *National Reporter* (newsletter).

For a more extensive listing of conservation organizations, see *The Conservation Directory* (published by the National Wildlife Federation).

APPENDIX C

Selected Conservation Laws

Copies of the Federal and State laws generally can be obtained from the administering agencies. Many of the major academic and public libraries have access to the laws and can be helpful locating copies.

Colorado Laws

Colorado Air Pollution Control Act (Title 25, Article 7).

Colorado Land Use Act [HB 1041] (Title 24, Article 65).

Colorado Minimum Stream Flow Act [Working Title of "S-97"] (Title 36, Article 31).

Colorado Natural Areas Act (Title 36, Article 10).

Colorado State Constitution, "Water" (Article 16, Section 56b).

Colorado Water Quality Control Act (Title 25, Article 8).

Department of Natural Resources Act (Title 24, Article 33).

Division of Wildlife and Division of Parks and Outdoor Recreation Laws (Title 33, Article 1-8; 20-23; 30-31; 40-43).

Local Government Land Use Control Enabling Act (Title 29, Article 20).

Mining Land Reclamation Act (Title 34, Article 32).

Nongame and Endangered Species Conservation Act (Title 33, Article 8).

Protection of Fishing Streams (Title 33, Article 5).

Protection of Land Resources Against Soil Erosion (Title 35, Article 72).

Soil Conservation Districts (Title 35, Article 70).

Standards for Drinking Water (Title 25, Article 1).

Federal Laws

American Antiquities Act of 1906.

Archeological and Historical Preservation Act of 1974.

Bald Eagle Protection Act of 1972.

Clean Air Act of 1963 and 1977.

Clean Water Act of 1977.

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Endangered Species Conservation Act of 1966, 1969, and 1973.

Environmental Education Act of 1978.

Federal Aid in Fish Restoration Act of 1950 (Dingell-Johnson Act).

Federal Aid in Wildlife Restoration Act of 1937 (Pittmans-Robertson Act).

Federal Environmental Pesticide Control Act of 1972.

Federal Land Policy and Management Act of 1976 (Bureau of Land Management Organic Act).

Fish and Wildlife Coordination Act of 1958.

Forest Service Act of 1905.

Forest and Rangeland Renewable Resources Planning Act of 1974, (Resources Planning Act).

General Mining Law of 1872.

Land and Water Conservation Fund Act of 1964, 1965 and 1976.

Migratory Bird Hunting Stamp Act of 1934.

Migratory Bird Treaty Acts of 1916 and 1936.

Mineral Act of 1972.

Mineral Leasing Act of 1920.

Multiple Use and Sustained Yield Act of 1960.

Multiple Use Mining Act of 1955.

National Environmental Policy Act of 1969.

"National Forests" Creative Act of 1891.

National Forest Management Act of 1976.

National Historical Preservation Act of 1966.

"National Parks" Act of 1916.

Organic Administration Act of 1897.

Pittman-Robertson Act of 1937.

The Reclamation Act of 1902.

The Safe Drinking Water Act of 1974 and 1977.

Soil and Water Resources Conservation Act of 1977.

Soil Conservation Act of 1935.

Taylor Grazing Act of 1934.

Toxic Substances Control Act of 1976.

Water Bank Act of 1970.

Water Pollution Control Act of 1972.

Wild and Scenic Rivers Act of 1968.

Wilderness Act of 1964.

Wild Horse and Burro Act of 1971.

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1978-1980 EDUCATIONAL PRIORITIES

As Adopted by The Colorado State Board of Education

Improvement of Basic Skills:

The Colorado Department of Education, through the accountability process and other proven methods, will help schools analyze and improve student skills in reading, writing, speaking, listening and mathematics.

Improvement of Discipline in Schools:

The Department will assist schools to achieve a learning climate for improved student discipline to enhance the learning process.

Improvement of Organization and Management of Education:

The Department will assist schools and libraries by coordinating and integrating state and local and federal programs to strengthen their skills in research, evaluation, and planning, for effective use of financial and human resources.

Improvement of Public Confidence in Education:

The Department will work with schools to improve public confidence in education through practical means including the state's accountability and accreditation processes and through increased involvement of the total community in the public school system.

Improvement of Equality of Access to Information:

The Department will identify and improve programs which assure equal access to information to help all Colorado citizens meet occupation, educational, and leisure time interests.

Improvement of Leadership and Staff Development:

The Department will further efforts to strengthen leadership skills of all professional staffs in the Department of Education, schools, boards of cooperative services, and libraries and library systems through increased in-service programs planned and offered cooperatively with higher education and other appropriate organizations.

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